Starrett®

MODEL 715
ELECTRONIC GAGE AMPLIFIER

REFERENCE MANUAL

Digitized by the Internet Archive
in 2025

https://archive.org/details/manualsplus_06923

CONTENTS

CONTENTS i

GAGE AMPLIFIER DATA BASE 1
- Meter Limits 1
- Meter Ranges 3
- System Parameters 3
- Parts 3
  - Part Identification 4
    - Part ID # 4
    - Description 4
    - Full Part # 4
    - Department 4
    - Company 4
  - Print List 4
  - Math Entries 5
  - Characteristic(s) 5
- Characteristics 5
  - Identification 5
    - Characteristic ID # 5
    - Description 6
    - Gage Identifier 6
    - Subgroup Size 6
  - Source/Function 6
    - Channel 6
    - Item 6

Data 7

OPERATING MODES 9
Mode Selection 9
RUN Mode 9
Channel Selection 10
Display Formats 11
Single-Channel Displays 11
Two-Channel Displays 13
Four-Channel Displays 14
RUN Mode Controls 15
Units 15
Range 15
Limits 16
Reset Data 17
Data Polarity 18
Setting Zero 18
Printing 19
Storing Readings 19
SETUP Mode 20
Mode Selection 20

MENUS 21
Menu Structure and Operation 21
Selecting Options and Menus, and Initiating Actions 21
Keyboard Data Entry 22
MAIN 23
SELECT PART (F2) 24
Part Selection 25
Part Information 25
Part Editing 26
Characteristic Selection 26
Characteristic Information 28
Characteristic Editing 28
Output Characteristic Reports 30
Column Format 30
CSV Format 31

DISPLAY FORMAT (F3) 31
Display Format Selection 31
Ranging Selection 32
MEMORY TRANSFER (F4) 32
Memory Card Operations (full menu) 33
Memory and Card Status 33
Memory Card Operations (abbreviated menu) 34
Memory Status 34
Memory Transfer Operations 34
SAVE ALL TO CARD (F3) 34
LOAD ALL FROM CARD (F4) 35
SAVE PART TO CARD (F7) 35
LOAD PART FROM CARD (F8) 35
Memory & Card Initialization (full menu) 36
Memory & Card Initialization (abbreviated menu) 37
Initialization Operations 37
CLEAR MEMORY (F1) 37
INITIALIZE MEMORY (F2) 38
CLEAR CARD (F5) 38
CALIBRATE PROBES (F5) 38
Calibration Operations 40
Coarse-to-Fine Ratio 40
Zero Point and Scale Factor 40
PARAMETER SET (F6) 42
First PARAMETER SET Menu 42
Time 42
Date 43
Display Digits 43
Inputs Active 44
Input Filter 44
Foot Switch 45
Continuous Print 45
Back Light 45
Second PARAMETER SET Menu 46
CSV Separator 46
PRINT L(i)ST SELECTION (F7) 47
Entering/Editing a Sequence of PRINT Steps 49

Operands 49
Separator Codes 51
MATH ENTRY (F8) 52
Selecting a Channel 52
Math Entry 53
Entering/Editing a Math Formula 55
Channel Operands 55
Fixed Constant Operands 56
Operation Codes 57

CALIBRATION AND ACCURACY 59
General Considerations 59
Operating Environment 59
Temperature 60
Water, Oil, and Dirt 60
Calibration 60
Initial Calibration 60
Battery Charging 61
Calibration During Use 62
Temperature Compensation 62
Disabling/Enabling Temperature Compensation 62
Temperature Compensation Offset 63
Other Factors Affecting Accuracy 64

APPENDIX A - INTERFACES 65
Probe Interfaces 65
Serial Interface 66
Printers 66
CRT Display Terminals 68
Computers 68
Input Character Set 69
AC Adapter Interface 72
Foot Switch Interface 72

APPENDIX B - DEFAULT PART SET 73

GAGE AMPLIFIER DATA BASE

The Gage Amplifier memory is used to hold a complete body of information on the parts to be tested and the results of tests. This information, the Gage Amplifier Data Base, describes the parts being tested, the particular characteristics of interest for each part, and the tests to be performed on them. It specifies any data-reduction processing to be applied to test results, and the format to be used in transmitting the data results to a printer, terminal, or computer. It also stores the data resulting from tests performed, both measured and mathematically-derived, for future reference.

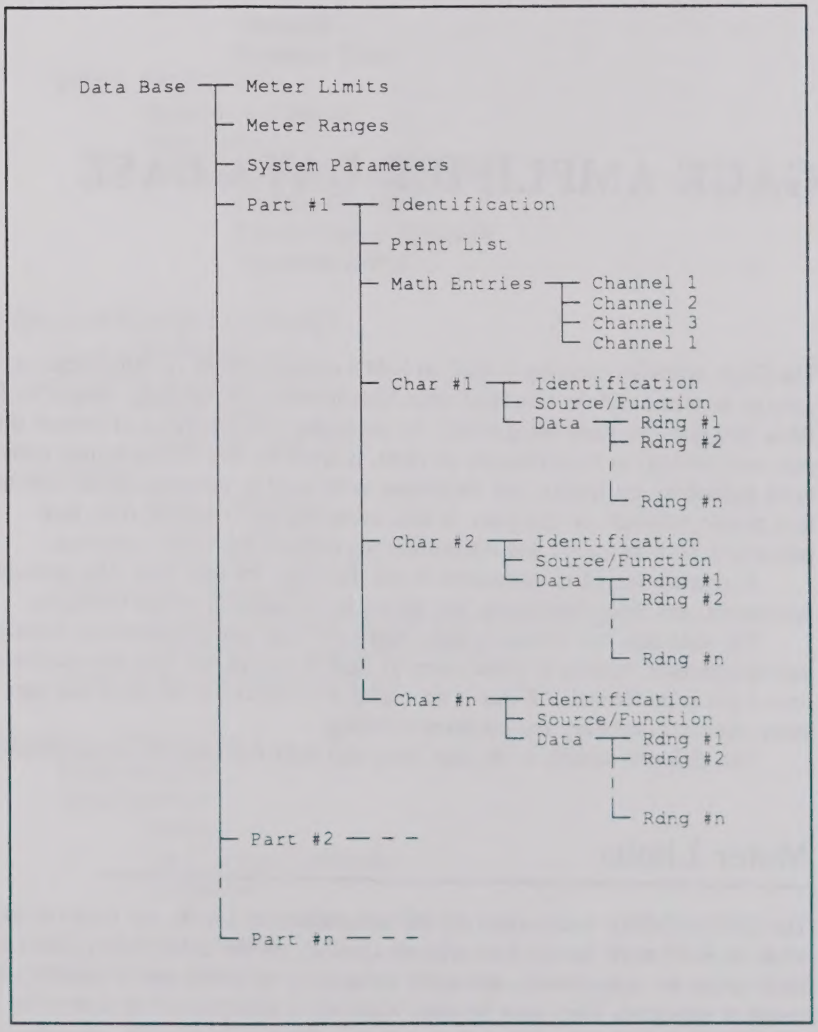
A separate record is maintained in the data base for each part. The elements of this record, and their relationship, are shown in the diagram on the next page.

The data base can contain a large number of part and characteristic descriptions and data records, making it unnecessary to load or key in new part information each time a test is performed. All that is necessary is to select the the particular part from those already in memory and commence testing.

The different records in the data base, and their functionality are as follows:

Meter Limits

The OVER/UNDER limit values for the four channels. Limits can be set at any time while in RUN mode for the then-selected channel, via the LIMITS key. The current limit values are system-wide, and apply irrespective of which part is currently being tested or inspected; They must be reset whenever a new part test or a new test setup is initiated.


Data Base
Meter Limits
Meter Ranges
System Parameters
Part #1
Identification
Print List
Math Entries
Channel 1
Channel 2
Channel 3
Channel 1
Char #1
Identification
Source/Function
Data
Rdng #1
Rdng #2
Rdng #n
Char #2
Identification
Source/Function
Data
Rdng #1
Rdng #2
Rdng #n
Char #n
Identification
Source/Function
Data
Rdng #1
Rdng #2
Rdng #n
Part #2 - - -
Part #n - - -

Meter Ranges

The current full-scale ranges for each of the four channel meter displays. Ranges can be set at any time while in RUN mode for the then-selected channel, via the RANGE← and RANGE→ keys. These range values apply irrespective of which part is currently being tested or inspected, so they must be reset whenever a new part test or a new test setup is initiated

System Parameters

A group of miscellaneous system data and control functions. Included in this group are:

The system real-time clock time and date
Flags controlling the precision of the numeric displays, the number of active channels, the action initiated by the foot switch, and the formaet of CSV output
Flags for turning on and off the input filter, continuous print mode, and the screen back lightontrol functions

These parameters can be changed at any time while in SETUP mode, from the PARAMETER SET menu (see **MENUS - PARAMETER SET**, below).

System parameters apply irrespective of which part is currently being tested or inspected, so they must be reset whenever a new part test or a new test setup is initiated

Parts

The data base can hold the data for many parts, identifying each part by a two digit ID number and description assigned by the user. Multiple parts can have the same part number and description, but this defeats the purpose of the identification, and is not recommended.

For each part, the following information is maintained:

Part Identification

A group of five fields for identifying the part in question. These fields are:

Part ID #	Full Part #
Description	Department
	Company

Part ID # (*)

A two digit number identifying the part for reporting purposes, arbitrarily assigned by the user when the part is entered in the data base.

Description (*)

A fifteen character field describing and identifying the part. Can be any combination of letters or numbers.

(*) The contents of these two fields are displayed in the Part Selection and Editing menus to allow identification of the curently selected part.

Full Part #, Department, & Company

Three other fifteen character fields to assist in describing and identifying the part. Each can be any combination of letters or numbers.

Print List

The program which selects and formats the data to be sent to the printer, remote display, or computer, when a **Print** operation is initiated. This program consists of the (up to) 24 program steps which can be entered via the Print List menu and stored in the collector memory. See **MENUS - PRINT LIST SELECTION**, later in this manual, for details on how this program is created and changed.

Math Entries

The four programs (one per channel) which perform data reduction calculations on the channel input data prior to printing/storing. Each of these programs consists of the (up to) 12 program steps which can be entered via the MATH ENTRY menu and stored in the collector memory. For details on how these programs are created and changed, see **MENUS - MATH ENTRY**, later in this manual.

Characteristic(s)

One or more sub-databases, each identifying a particular measurement of the part in question. Contains several data fields describing the characteristic and its source, and all of the currently stored measurement data for that characteristic. (see below)

Characteristics

For each part, the data base can hold the data for a number of dimensions to be tested. These dimensions are known as characteristics, and are each identified by a three digit ID number and a characteristic description, assigned by the user. Multiple characteristics of the same part can have the same number and description, but this defeats the purpose of the identification, and is not recommended.

For each characteristic of each part, the following data fields are maintained:

Identification

A group of five fields for identifying the part in question. These fields are:

Characteristic ID #	Gage Identifier
Description	Subgroup Size

Characteristic ID # (*)

A three digit number identifying the characteristic for reporting purposes, arbitrarily assigned when the characteristic is entered in the data base.

Description (*)

A fifteen character field describing and identifying the characteristic. Can be any combination of letters or numbers.

(*) The contents of these two fields are displayed in the Characteristic Selection and Editing menus to allow identification of the currently selected characteristic.

Gage Identifier

A fifteen character field to assist in describing and identifying the characteristic. Can be any combination of letters or numbers.

Subgroup Size

A two digit number identifying the number of samples per test subgroup. Used during testing to inform the operator how many samples need to be taken, When a new characteristic is created, the subgroup size is initially set to a default value of 5.

Source/Function

Two fields, Channel and Function, identifying the origin of the data for this characteristic.

Channel

The number (1 through 4) of the channel whose input is to be used in measuring this characteristic.

Item

The particular function of the identified channel which is to be printed and/or stored for this characteristic. The function selected can be the measured value of the channel input (Val), any of several sampled functions of the channel input (Max, Min, TIR, Avg, or N), or the math function defined for the channel. See **MENUS - PRINT LIST SELECTION**, later in this manual, for definitions of these functions.

Data

All measurements made of a particular characteristic form part of that characteristic's record. Each measurement forms a separate record, consisting of the value, and the time and date when the measurement was made. Measurement data is stored each time a **Store** function is executed, a record being created for each characteristic of the current part and added to that characteristic's record.

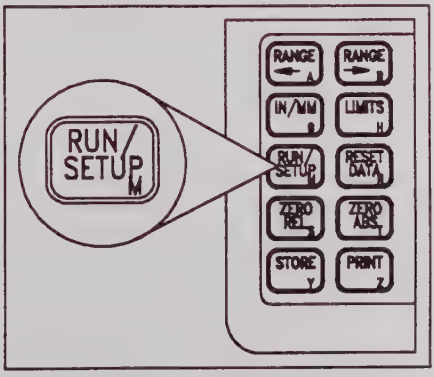
Characteristic data can only be deleted while in SETUP mode, by executing a DELETE READINGS command from the CHARACTERISTIC INFORMATION menu. See **MENUS - SELECT PARTS**, later in this manual, for a description of this operation.

OPERATING MODES

The 715 has two basic operating modes: **RUN** mode, when it is displaying gage data, and **SETUP** mode, when menu screens are being used to change operating parameters.

Mode Selection

The system can be toggled back and forth between **RUN** mode and **SETUP** mode by pressing the RUN/SETUP key on the left hand side of the main keyboard.



RUN Mode

In **RUN** mode the 715 is displaying the data from one or more gage inputs. Data from a single gage input is displayed full screen; data from multiple gage inputs is

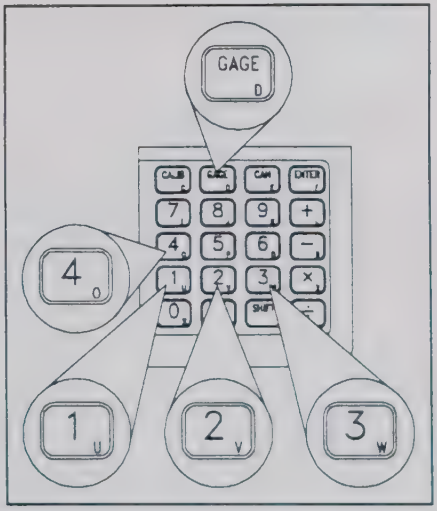
displayed split screen, with either 2 channels (always channels 1 & 2) or all 4 channels displayed at a time. When the data from multiple inputs is displayed, one is designated by the system user as the "active" channel; when the data from a single input is being displayed, it is, by default, the "active" channel.

When in **RUN** mode, operation is controlled from the other 9 keys on the left hand side of the main keyboard, plus the GAGE and '-' keys, and the keys for the numerals 1 through 4.

Only the currently active channel is affected by these keys.

Channel Selection

The operator controls which channel is "active", and currently being displayed as follows:



When displaying the data from a single channel, the active channel is indicated numerically at the top of the screen. To change the active channel, press the the GAGE key; this will cause the system to advance to display the next channel, in round-robin fashion. The channel number advances once for each time the GAGE key is pressed.

When displaying the data from two channels (always channels 1 & 2), or from all four channels, the active channel is indicated by a "pointing-finger" graphic symbol on the screen. To change the active channel, press the numeric key, 1, 2, 3, or 4, corresponding to channel desired.

When displaying data from a single channel, the numeric keys will have no effect; when displaying data from multiple channels, the GAGE key will have no effect.

Display Formats

The data from the gage input(s) is displayed on the screen both graphically and numerically.

The graphic display shows the data as it would appear if the gage were connected directly to a meter. A zero-center meter scale is displayed, with an arrow (representing the meter "needle") pointing to the data value. Figures displayed at either end of the scale indicate the full-scale range of the display, and a pair of small tick marks adjacent to it mark the present value of the limits for the channel being displayed. As the gage data changes, the "needle" tracks it, moving to the point corresponding to the new value.

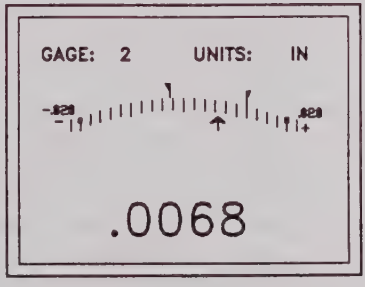
The numeric display is a signed decimal number representing the gage output value, shown on the screen immediately below the meter face. This number can be set by the user to have from 1 to 6 significant digits; see **MENUS - PARAMETER SET**, later in this manual, for details.

The Gage Amplifier can be programmed to display a single channel, two channels, or all four channels at a time. When displaying a single channel, any of the four channels can be chosen for display; when displaying two channels, only channels 1 & 2 can be displayed; when displaying four channels, all channels are shown on the screen at once

Ten different display formats are available for selection, as listed below.

Single-Channel Displays

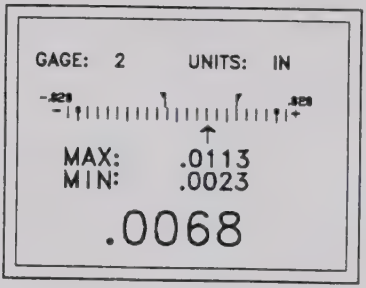
Curved Horizontal Meter



This is the default meter screen displayed when the unit is first turned on.

In this display, the gage number and the units (INches vs MM) are shown above the meter face, near the top of the screen, and the limit status (OVER, if the data is above the upper limit, or UNDER, if below the lower limit) is displayed directly above the associated end of the meter scale.

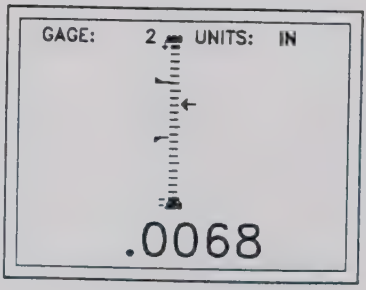
Flat Horizontal Meter



In this display, the gage number and the units (INches vs MM) are shown above the meter face, near the top of the screen, and the limit status (OVER, if the data is above the upper limit, or UNDER, if below the lower limit) directly above the associated end of the meter scale.

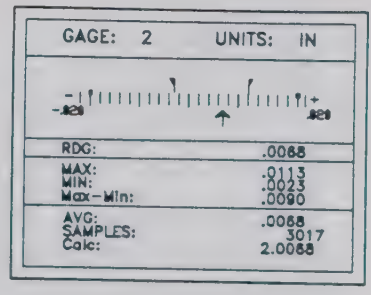
The current values of MAX and MIN for the channel are shown immediately below the meter face, between it and the numeric data display.

Vertical Meter



In this display, the gage number and the units (INches vs MM) are shown above the meter face, near the top of the screen, and the limit status (OVER, if the data is above the upper limit, or UNDER, if below the lower limit) immediately to the left of the associated end of the meter scale.

Flat Horizontal Meter w/Sampled Data

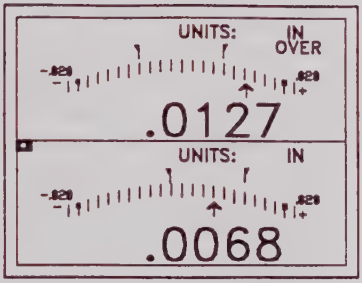


In this display, the gage number and the units (INches vs MM) are shown above the meter face, near the top of the screen, and the limit status (OVER, if the data is above the upper limit, or UNDER, if below the lower limit) directly above the associated end of the meter scale.

Below the meter face and the numeric data display, in the bottom half of the screen, are shown the current values of the sampled-data functions for the channel: MAX, MIN, MAX-MIN, AVG, and SAMPLES (the number of times the data has been sampled since the last RESET DATA operation), and the value of the MATH ENTRY function currently defined for the channel.

Two-Channel Displays

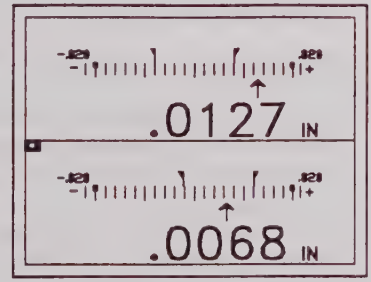
Two Curved Horizontal Meters



The screen is divided in half horizontally, with the meter for channel 1 shown in the top half, and that for channel 2 in the bottom half.

In this display, the units (INches vs MM) are shown above the meter face, near the top of each half of the screen, and the limit status (OVER, if the data is above the upper limit, or UNDER, if below the lower limit) directly above the associated end of the meter scale.

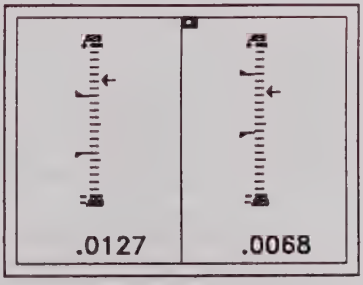
Two Flat Horizontal Meters



The screen is divided in half horizontally, with the meter for channel 1 shown in the top half, and that for channel 2 in the bottom half.

In this display, the units (INches vs MM) are shown to the right of the numeric data display, near the bottom of each half of the screen.

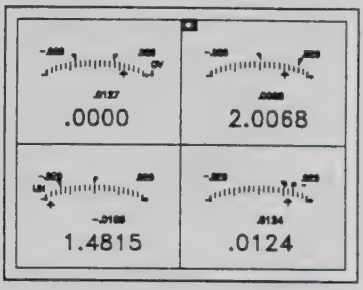
Two Vertical Meters



The screen is divided in half vertically, with the meter for channel 1 shown in the left half, and that for channel 2 in the right half.

Four-Channel Displays

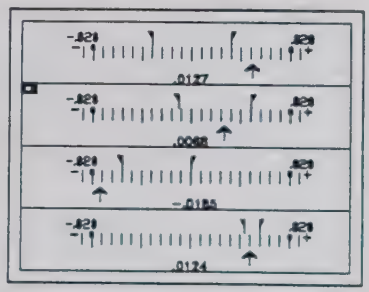
Four Curved Horizontal Meters



The screen is divided in half horizontally and vertically, with the meter for channel 1 shown in the top left quadrant, that for channel 2 in the top right, that for channel 3 in the bottom left, and that for channel 4 in the bottom right.

In this display, the limit status (OV, if the data is above the upper limit, or UN, if below the lower limit) is displayed directly above the associated end of the meter scale, and the value of the MATH function currently defined for the channel is shown below the numeric data display, in each quarter of the screen.

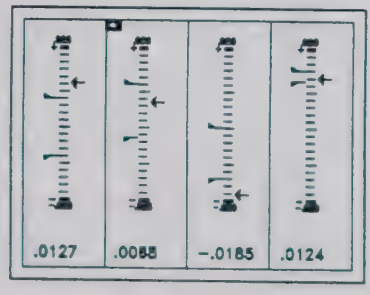
Four Flat Horizontal Meters



The screen is divided in quarters horizontally, with the meter for channel 1 shown at the top, and the meters for channels 2, 3, and 4 in succession below.

In this display, only the meter faces and the numeric data displays are shown; no other information is displayed.

Four Vertical Meters

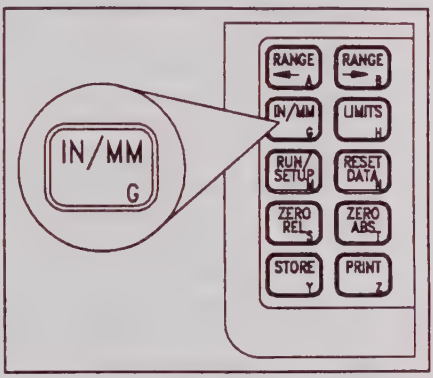


The screen is divided in quarters vertically, with the meter for channel 1 shown at the left, and the meters for channels 2, 3, and 4 in successionto its right.

In this display, only the meter faces and the numeric data displays are shown; no other information is displayed.

RUN Mode Controls

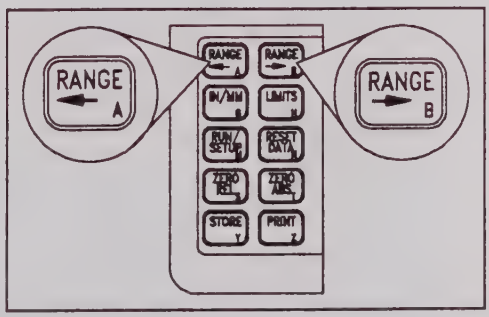
Units



The data from the gage inputs is displayed in either English (inches) or metric (mm) units. Pressing the IN/MM key causes the system to toggle between the two types. Both the numeric and the graphic displays are changed, and all four channels, including those not being currently displayed, are affected.

When switching between the two types of units, the full scale limits of the meter will be modified by a factor of 10 to compensate, more or less, for the difference in magnitude of the two units, inches and millimeters. Thus a display in which the meter range was ±.001 inches would switch to a display with a meter range of ±.010 mm, and one with a meter range of ±2.000 mm inches would change to one with a meter range of ±.200 inches, etc.

Range



The full-scale meter range of each channel can be any one of eight values from ±.0001 inches to ±.200 inches, if displaying English units, or from ±.0010 mm to ±2.000 mm, if displaying metric units. Meter range can be either selected explicitly by the user, or programmed to be automatically selected by the Gage Amplifier.

If user-selected, meter range is set on a channel by channel basis, using the two keys, RANGE← and RANGE→.

RANGE← lowers the range (±.200 ⇒ ±.100 ⇒ ±.020 ⇒ ±.010 ⇒ ...) of the active channel; RANGE→ raises it (±.0001 ⇒ ±.0002 ⇒ ±.001 ⇒ ±.002 ⇒ ...).

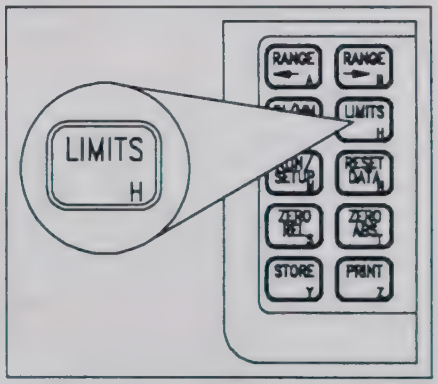
If automatically selected, meter range is set on a channel by channel basis by the 715, the range for each channel being selected so as to display the gage data for that channel as close to full scale as possible. As the data changes, the 715 will track it and change the meter range to a higher or lower value as appropriate without operator intervention.

The type of ranging in effect is controlled from the DISPLAY FORMAT menu. See **MENUS - DISPLAY FORMAT**, later in this manual, for details.

Whichever ranging mode is in effect applies to all four channels uniformly; it is not possible to have auto-ranging in effect on some channels while user range selection is in effect on the others.

Range selection affects only the format of the displayed meter face, and has no effect on the format and precision of the numeric display; the format and precision of that part of the display are set from the PARAMETER SET menu. See **MENUS - PARAMETER SET**, later in this manual, for details.

Limits



A High and a Low limit value exist for each channel, and each can be set to any desired value. Pressing the LIMITS key causes the screen to display the limit settings for the currently active channel; to display the limit settings for some other channel, press the numeral key corresponding to the desired channel after pressing LIMITS. A limit is selected for changing by pressing one of two function keys, F1 to change the upper limit, F2 to change the lower. When the function key is pressed, a line of UNDERSCORE characters (_ _ _ _ _) will be shown on the display at the location where the limit data is to be entered. The length of this line indicates the maximum number of characters which can be entered, and a cursor (a blinking UNDERSCORE just below the line) indicates where the next character

entered will be placed. The new value for the limit is then typed in, using the keys for the ten numeric digits and the '-' and '.' keys, with the sign (if negative) being entered first.

If an incorrect character is accidentally entered, it can be erased by pressing the CAN (CANcel) key. Pressing CAN when the cursor is at the first position cancels the data entry operation, returning the data to its original value.

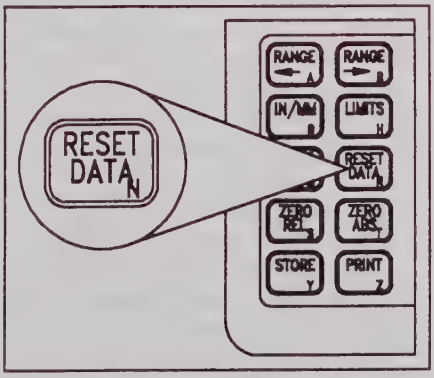
When the data has been correctly entered, pressing the ENTER key causes it to be accepted and stored in memory. Pressing ENTER when the cursor is at the first position enters a value of ZERO for the data.

When limit setting is complete for all desired channels, press PREV. This will cause you return to the measurement screen for the channel whose limit settings were being displayed at the time of return.

Limits are indicated in the data display by pointers adjacent to the meter scale, on the opposite side from the "needle".

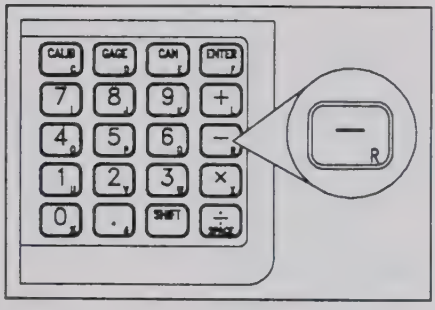
On some meter screens, if the reading is above the high limit, the word OVER or OV is displayed. When the reading is below the low limit, the word UNDER or UN is displayed. See the meter screen descriptions above to find out which display formats ahve this feature.

Reset Data



While in **RUN** mode, the input data on all four channels is regularly sampled, and data attributes computed for each channel: MIN (the lowest data value for a channel since the start of sampling), MAX (the highest data value for a channel since the start of sampling), and AVG (the average data value for a channel since the start of sampling). These attributes, along with SAMPLES (the number of times that data on the four channels has been sampled), are included in the data shown in two of the single-channel data displays. In order to initialize these attributes, press the RESET DATA key; this causes MIN, MAX, and AVG for each channel to be set to the current data value for that channel, and SAMPLES to be set to zero.

Data Polarity

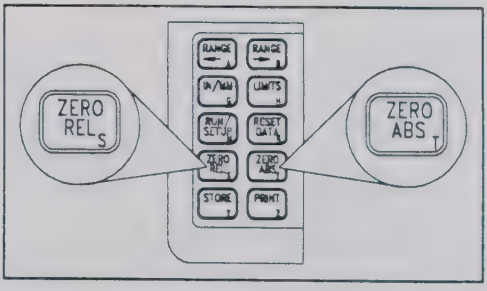


Pressing the "–" key while in RUN mode has the effect of reversing the polarity of the gage reading. If the gage reading, for example, is +.01002, then pressing "–" will cause it to change to -.01002. Pressing the key again will have the effect of reversing the polarity again, back to the original value. Both the needle position and the numeric display are affected.

The polarity of the "meter" itself, and of the limits, is not affected by this key; only the data polarity is changed.

Setting Zero

There are two methods of setting zero, absolute (ZERO ABS) and relative (ZERO REL).

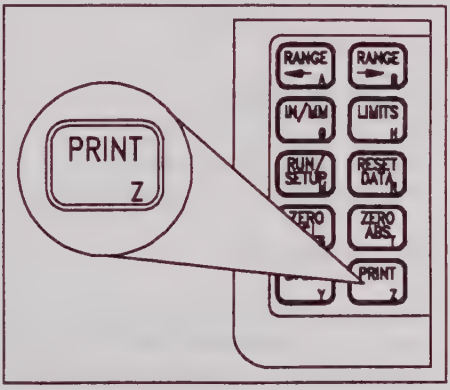


Pressing ZERO ABS tells the 715 to interpret half of the end-to-end probe signal swing as an indication of zero displacement, and thus display zero at the midpoint of the probe travel. The probes used by the 715 are most accurate when operated at their balance point, at or near this midpoint; using this point as zero thus maximizes the achievable accuracy.

Pressing ZERO REL tells the 715 to sense and remember the probe output voltage at that instant as the voltage to be interpreted as zero, irrespective of whether the probe is balanced or not. This labels the current probe position as the zero point, and forces all future measurements to be expressed as offsets relative to that position.

This realtive zeroing capability is useful when checking a part against a master, as follows: With the probe on the master press ZERO REL. Then replace the master under the probe with the part to be checked. The resulting indication will be the physical difference in size between that part and the master.

Printing

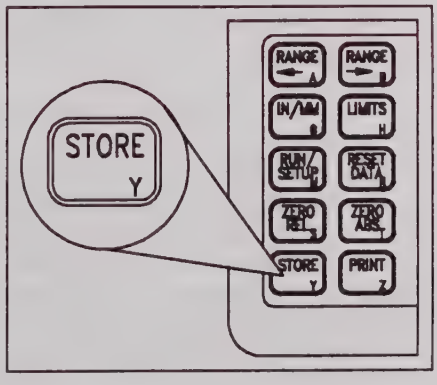


Pressing the PRINT key causes test information to be sent from the serial data port to whatever device is connected to it. This device can be a printer, for hard copy recording, a terminal, for display, or a computer, for display and recording.

The information transmitted can be programmed by the user to be any combination of data values, sampling functions, and math functions. formatted as desired. The program which controls this data and format is accessed via the PRINT LIST menu; see **MENUS - PRINT LIST**, later in this manual.

When a default part set is loaded, either at power up, or by the user, via the MEMORY TRANSFER menu, a default Print List program for part #10 is also loaded. This default program will cause the transmitted information to consist of the measured value on channel 1, followed by a carriage return/line feed. No Print List programs are loaded for either of the other two parts.

Storing Readings



Pressing the STORE key causes the current value for each characteristic to be stored in the 715 memory for later retrieval or printout.

The value stored in each case is whatever is specified for that characteristic, in the data base for the currently selected part. It can be the data value, or a sampling function, or the result of any of the four mathematical functions, for any of the four channels.

The channel and function for each characteristic is selected via the CHARAC-

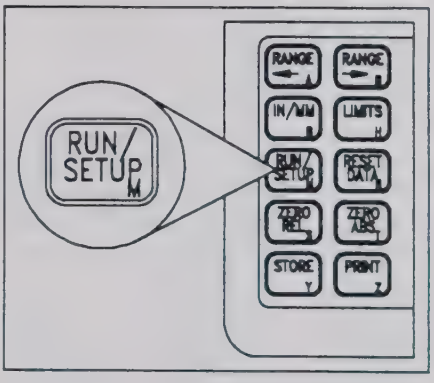
TERISTIC ENTRY menu, with the MATH ENTRY menu being used to program the math function, if selected. See **MENUS - SELECT PARTS (F2)** and **MENUS - MATH ENTRY (F8)**, below, for more information.

SETUP Mode

SETUP is the 715 operating mode in which system parameters are changed, and in which non-display system operations are initiated.

Mode Selection

The system can be toggled back and forth between **RUN** mode and **SETUP** mode by pressing the yellow-lettered RUN/SETUP key on the left hand side of the main keyboard. The system can return to **RUN** mode from any of the **SETUP** mode selection menus, except when actually in the process of entering a parameter or description, or performing an operation (in such cases, the RUN/SETUP key will be ignored) . When entering **SETUP** mode, the system returns to the menu which was active when it last exited **SETUP** mode.



MENUS

Menu Structure and Operation

In **SETUP** mode, the particular function to be changed or operation to be initiated is chosen by making selections from a menu. Many different menus are provided, each for a specific type of operation or data entry. For ease of access, they are divided into seven sets, grouped by functionality, called from a single master menu with the name MAIN. Some of the sets, such as the DISPLAY FORMAT set, consist of only a single menu. Others, such as the SELECT PART set, are composed of a number of menus, each dealing with a particular subtask.

The MAIN menu itself performs no direct system operation; its sole purpose is to call whichever set of the special-function menus is required, and to identify the currently selected part.

The way in which these menus are organized into these seven sets is shown in the diagram on the next page.

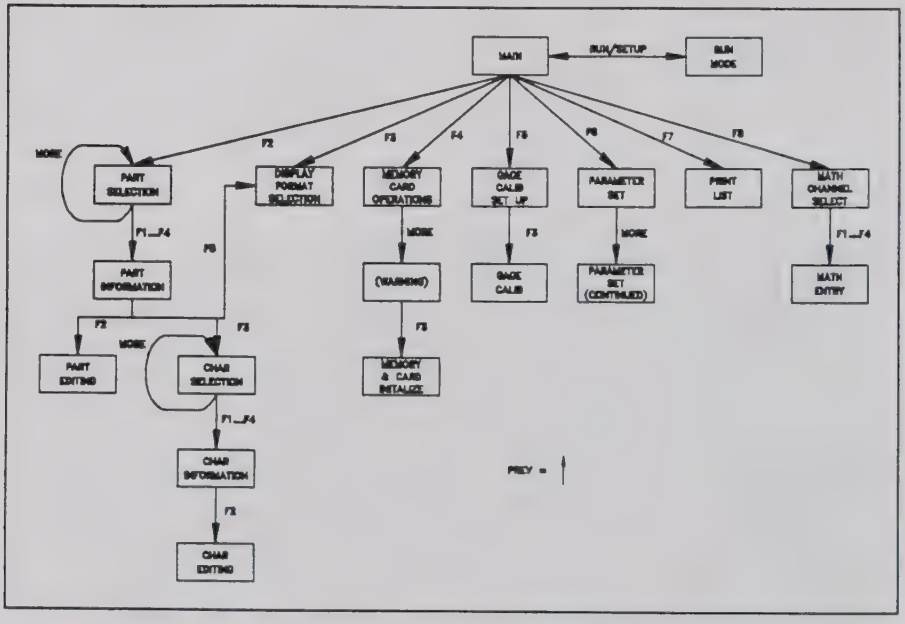
Selecting Options and Menus, and Initiating Actions

In all menus, options are selected either by pressing one of several function keys adjacent to a set of selection names, or by stepping through a set of choices by repeatedly pressing the single function key adjacent to the option name.

Menus are selected by pressing one of several function keys adjacent to a set of menu or function names. If the number of selections for a menu is greater than eight (the number of function keys), necessitating a second menu, or if a follow-on menu is required to offer choices of a different class, this will be identified by the display of a

rectangular black mark at the bottom of the screen, directly above the MORE key. Pressing this key will then invoke the indicated follow-on menu.

Actions are initiated from a menu by pressing the function key adjacent to the name of the action.



Keyboard Data Entry

Whenever the 715 expects data entry from the keyboard, a line of UNDERSCORE characters (_ _ _ _ _) will be shown on the display at the location where the data is to be entered. The length of this line indicates the maximum number of characters which can be entered, and a cursor (a blinking UNDERSCORE just below the line) to indicate where the next character entered will be placed. The ten numeric digits (0 ... 9), the decimal point (.), and the symbols for the four arithmetic operations (+, −, ×, and ÷) can be entered directly. The 26 alphabetic characters (A ... Z), the percent and number signs (% and #), and the space ( ) are entered by holding down the SHIFT

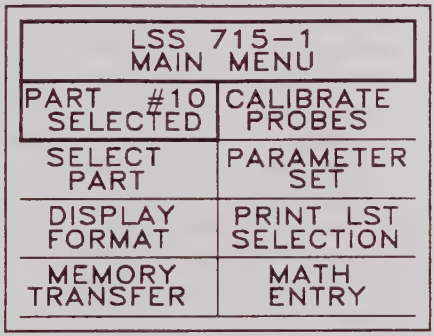
key while pressing the appropriate key as indicated by the legend at that key's lower right hand corner.

If an incorrect character is accidentally entered, it can be erased by pressing the CAN (CANcel) key. Pressing CAN when the cursor is at the first position cancels the data entry operation, returning the data to its original value.

When the data has been correctly entered, pressing the ENTER key will cause it to be accepted and stored in memory. Pressing ENTER when the cursor is at the first position enters a value of ZERO for the data.

MAIN

The MAIN menu is the entry point for the menu structure. It displays the names of the seven functionally grouped sets of menus, and allows the user to select whichever set is required. Selection is accomplished by pressing the function key adjacent to the name of the set of menus you wish to use. The seven sets of special-function menus are: SELECT PART (F2), DISPLAY FORMAT (F3), MEMORY TRANSFER (F4), CALIBRATE PROBES (F5), PARAMETER SET (F6), PRINT LIST SELECTION (F7), and MATH ENTRY (F8). F1 is not used.



To call a special-function menu set from the MAIN menu, press the function key, F2 through F8, which has the name of the desired menu set displayed next to it.

The MAIN menu is also used to display the number of the currently selected part. This information appears on the screen in a box adjacent to the unused F1 function key. Whenever a new part is selected, this part of the MAIN menu is updated, to assure the operator that the correct part has been selected for the current test.

When in a menu set, return to the MAIN menu is effected by pushing the PREV (Previous) key, below the display screen, one or more times.

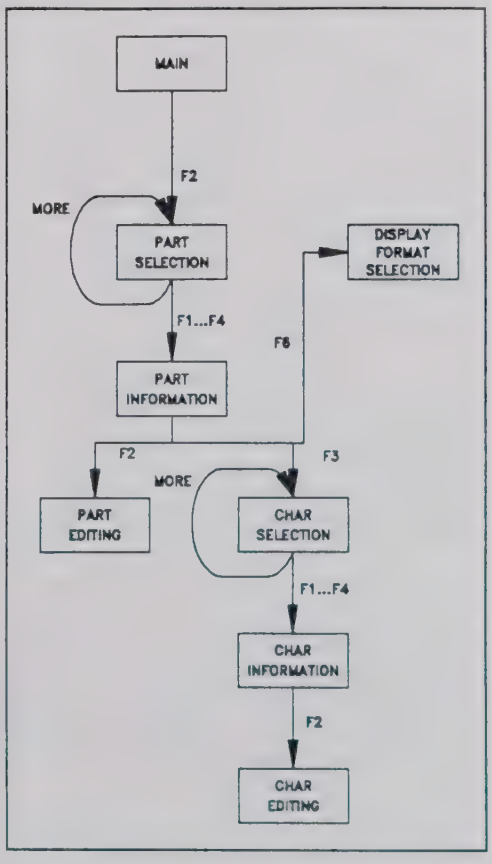
In order to go from one set of menus to another, it is necessary to first return to the MAIN menu, and then invoke the second set from there.

The functionality and use of these menus are described below.

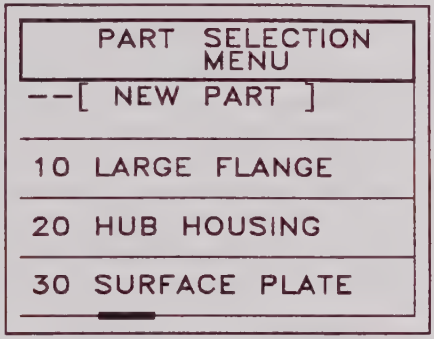
SELECT PART (F2)

The 715 maintains a list in its memory of the parts to be measured, with associated information for each part as to part number, vendor, etc., characteristics to be tested, and format in which to store or display or print test results. It also maintains records of all measurement data for each part and characteristic.

SELECT PARTS invokes a set of menus which are used to add or delete parts to/from the parts list, to enter and modify their associated information, and to transmit, display, and delete measurement data when appropriate. There are six menus in this set: PART SELECTION, PART INFORMATION, PART EDIT, CHARACTERISTIC SELECTION, CHARACTERISTIC INFORMATION and CHARACTERISTIC EDIT. They are organized as shown in the accompanying diagram.



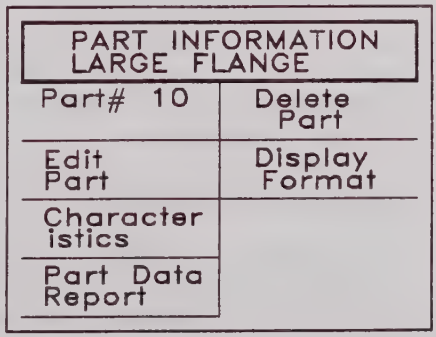
Part Selection



The first menu displayed, the PART SELECTION menu, is used to choose which part is to have its associated information displayed, modified, or entered. The user is prompted by a list of all currently defined parts (plus [New Part], a menu entry for adding a part not currently in the list). If more parts are currently defined than can be listed on a single screen, [New Part], plus the first three that currently exist, will be shown initially. Pressing MORE will cause the next four to be shown, then the next four, etc, until the last part is reached, at which point the message "End of List" will be displayed.

The part to be edited (or the new part to be added) is selected by pressing the function key to the left of its number/name when it is displayed on the screen.

Part Information



As soon as the part, new or old, has been selected, the PART INFORMATION menu is displayed. In this menu the user can: enter/modify the part number (F1), go to the PART EDITING menu (F2), go to the CHAR SELECTION menu (F3), transmit a part data report to whatever device is connected to the RS232 I/O port (F4), delete the part fromthe system list (F5), or call the DISPLAY FORMAT menu (F6).

For three of these choices, EDIT PART (F2), CHARACTERISTICS (F3), and DISPLAY FORMAT (F6), a new menu is displayed, and the user must indicate a further choice.

If PART # (F1) is pressed, the user is prompted for a new part ID # with a line of UNDERSCORES.

If PART DATA REPORT (F4) is pressed, a report on the part will be transmitted via the serial port to whatever display/processing device it is connected to. A typical Part Data Report is shown below:

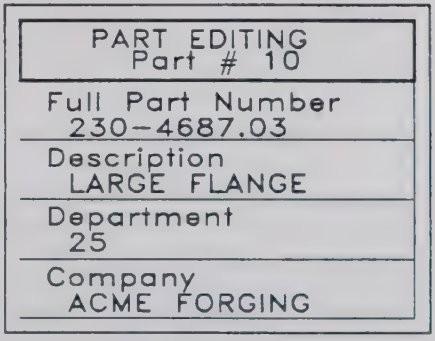
If DELETE PART (F5) is pressed, a screen will be displayed asking if that was really the user's intention. This can be answered in the affirmative by pressing F1, or the operation can be cancelled by pressing PREV.

Before a part can be deleted, all of its characteristics must first have been deleted. If, when F1 is pressed, the part in question has any characteristics remaining, the system will announce that fact and refuse to carry out the operation.

If DISPLAY FORMAT (F6) is pressed, the effect will be the same as if DISPLAY FORMAT had been selected from the MAIN menu. See **MENUS - DISPLAY FORMAT (F3)**, below, for a description of this functionality.

Part Editing

The PART EDITING menu is for entering or modifying the Full Part Number (F1), the Part Description (F2), the Department name (F3), or the Company name (F4) for this part. When the function key is pressed, the unit will prompt the user for a new value of the associated data field with a line of UNDERSCORES. When the data has been correctly entered, pressing the ENTER key will cause it to be accepted and stored in memory.



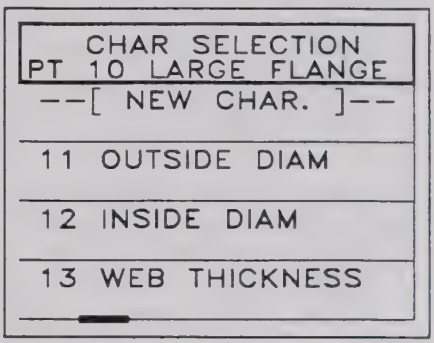
Characteristic Selection

The CHAR(acteristic) SELECTION menu is used to identify which characteristic of the currently selected part is to be entered or modified The user is prompted by a list of all currently defined characteristics (plus [New Characteristic], a menu entry for adding a characteristic not currently in the list) for the part in question. If more characteristics are currently defined than can be listed on a single screen, the message

```
                        Part Data Report
Part Id # 10
Part Number: 230-4687.03
Description: LARGE FLANGE
 Department: 25
    Company: ACME FORGING

Limits            Upper      Lower
Channel#  1    .008000   -.008000
Channel#  2    .012000   -.003000
Channel#  3    .000000   -.014000
Channel#  4    .014000    .011000


Number of Characteristics:  3

                        Characteristic Data
Char Id # 11
Description: OUTSIDE DIAM
Gage Identifier: .02 IN #3441
Subgroup Size:  5
Channel:  1  Item: Val
Number of readings stored:     7

30    05/07/1993 13:27     .01196
10    05/07/1993 13.29     .01201
10    05/07/1993 13.32     .00985
10    05/07/1993 13.33     .01303
10    05/07/1993 13.35     .01298
30    05/07/1993 13.35     .01073
10    05/07/1993 13.36     .01039

                        Characteristic Data
Char Id # 12
Description: INSIDE DIAM
Gage Identifier: .02 IN #5011
Subgroup Size:  5
Channel:  2  Item: Val
Number of readings stored:     7

30    05/07/1993 13:27     .00450
10    05/07/1993 13.29     .00921
10    05/07/1993 13.32     .00387
10    05/07/1993 13.33    -.00254
10    05/07/1993 13.35     .00148
30    05/07/1993 13.35    -.00016
10    05/07/1993 13.36    -.00130

                        Characteristic Data
Char Id # 13
Description: WEB THICKNESS
Gage Identifier: .01 IN #43
Subgroup Size:  5
Channel:  3  Item: Val
number of readings stored:     7

30    05/07/1993 13:27     .01204
10    05/07/1993 13.29     .01223
10    05/07/1993 13.32     .01198
10    05/07/1993 13.33     .01264
10    05/07/1993 13.35     .01181
30    05/07/1993 13.35     .01273
10    05/07/1993 13.36     .01215
```

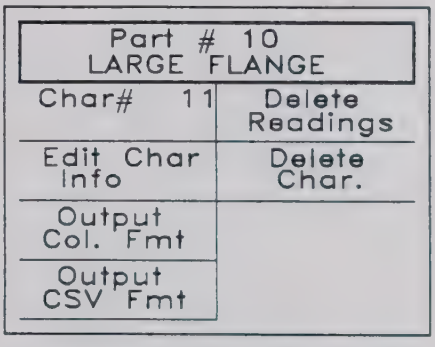
[New Characteristic], plus the first three that currently exist, will be shown. Pressing MORE will cause the next four to be shown, then the next four, etc, until the end of the list is reached, at which point the message "End of List" will be displayed.

The characteristic to be edited (or the new characteristic to be added) is selected by pressing the function key next to it when it is displayed on the screen.



Characteristic Information

As soon as the characteristic, new or old, has been selected, a Characteristic Information menu is displayed. In this menu, which has no formal name, the user can: Enter or modify the characteristic number (F1), go to another menu (see below) to enter or modify other characteristic data (F2), cause an Output Characteristic report to be sent to whatever device is connected to the RS232 I/O port, in either Column format (F3) or CSV (Comma Separated Variable) format (F4), delete all stored measurement data relating to this characteristic of this part (F5), or delete this characteristic itself from the part record (F6). For one of these choices, CHAR(acteristic) #, the unit will prompt the user for a new value with a line of UNDERSCORES; for the others, either the indicated menu will be displayed, or action taken.



Characteristic Editing

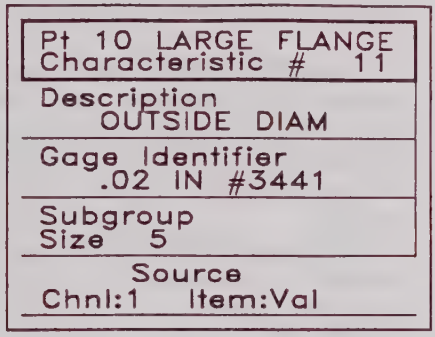
In the Characteristic Edit menu, invoked by pressing F2 (above), any of five characteristic specification items can be entered or changed.

For two of these, Characteristic Description (F1) and Gage Identifier (F2), the unit will prompt with a line of UNDERSCORES for an ASCII string to be used for

characteristic identification.

Pressing Subgroup Size (F3),wil cause the unit to prompt with a pair of underscores for a number indicating how many readings are to be grouped into each subgroup for reporting purposes (see **Characteristic Information**, above).

Pressing Source Channel (F4) steps through the four possible channels in round robin fashion to select a source for this characteristic.



Pressing Source Item (F8) steps through the list of possible functions of the selected channel in round-robin fashion until the desired function to be stored is displayed. It is possible to select the raw channel input, any of several statistical sampling derivatives of the channel input, or the math function defined for that channel (see **MENUS - MATH ENTRY**, below). The different channel functions which can be selected are:

[Val]	Value	The measured value of the specified channel input.
[Max]	Maximum	The maximum sampled value on the specified channel since the beginning of sampling.
[Min]	Minimum	The minimum sampled value on the specified channel since the beginning of sampling.
[TIR]	Total Indicated Runout	The difference between the maximum sampled value and the minimum sampled value on the specified channel since the beginning of sampling.
[Avg]	Average	The average of all sampled values on the specified channel since the beginning of sampling.
[N]	Samples	The number of times the specified channel has been sampled since the beginning of questioning.
[Math]	Math Function	The result of the curently specified mathematical function for the specified channel.

Output Characteristic Reports

An Output Characteristic report is a report of all measurements made on a single characteristic of a single part. Such a report is made by sending out a block of data via the serial data port to whatever device is currently connected to it, and the data consisting of the stored characteristic data, plus enough information to identify the date and time the measurements were made, and which subgroup of parts were being measured.

The characteristic/part whose data is printed out is the currently selected characteristic of the currently selected part. All curently stored data for that characteristic is printed; no data is printed for any other parts or any other characteristics.

The Gage Amplifier can print out a characteristic report in either of two formats, Column format (by pressing F3), or CSV (Comma-Separated Value) format (by pressing F4).

Column Format

In column format, the data is printed out one reading per line, at maximum precision (6 digits), with each line being terminated by a carriage return. Each line begins with a number indicating whether the reading is the first reading in a subgroup (30 = first; 10 = not first), then the date and time at which the reading was made, and then the data. All elements on each line are separated by spaces.

A sample of an Output Characteristic Report in Column format is shown below.

```
30  05/18/93  09:43   .001899
10  05/18/93  09:46   .002178
10  05/18/93  09:48  -.001045
10  05/18/93  09:51   .001104
30  05/18/93  10:11   .006541
10  05/18/93  10:14   .004810
 :      :       :        :
 :      :       :        :
```

CSV Format

In CSV format, the data is printed out with all readings from a subgroup on a single line, at maximum precision (6 digits), separated by commas, with each line being terminated by a carriage return character. Each line begins with a header consisting of: the date on which the first reading in the subgroup was made, and the time of day at which the first reading of the subgroup was made. The header is separated from the data by either another comma, or by two semicolons.

A sample of an Output Characteristic Report in CSV format is shown below:

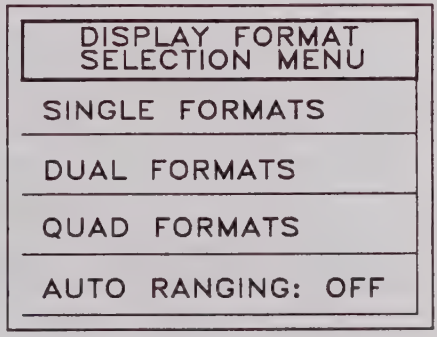
```
05/18/93 09:43,  .001899,  .002178, -.001045,  .001104
05/18/93 09:51,  .006541,  .004810, ...
```

DISPLAY FORMAT (F3)

The Display Format menu controls how the display will appear during RUN mode. It is used to set the number of channels being displayed, the type of meter face depicted, and what other data, besides the current value, is shown on the screen. It also allows the user to specify the type of range selection, manual or automatic, to be used.

Display Format Selection

To choose a display format, select the DISPLAY FORMAT setup menu, and press either F1, F2, or F3, depending whether you wish to display one, two, or four channels. Then press the MORE key repeatedly to cycle through the display formats available (see DISPLAY FORMATS, under **RUN** mode) for that number of channels. When you have chosen the format you wish, press ENTER to select it and return to the DISPLAY FORMAT menu.



Ranging Selection

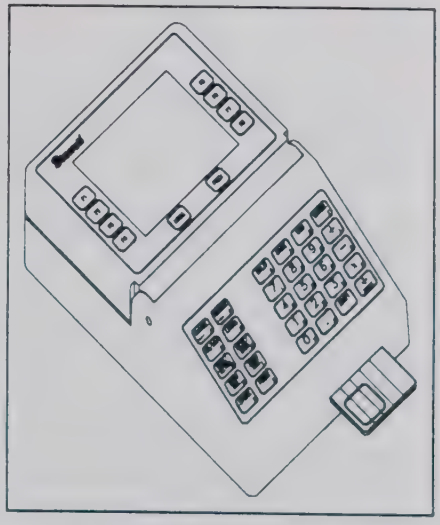
The type of ranging performed is selected by pressing F4. Each time this function key is pushed, the 715 will toggle between user range selection and auto-ranging. The type of range selection in effect is indicated by the word ON or OFF below the name AUTO RNG. in the display box next to F4.

Whichever type of display range selection is in effect applies to all four channels uniformly; it is not possible to have auto-ranging in effect on some channels while user range selection is in effect on the others

MEMORY TRANSFER (F4)

Pressing F4 (MEMORY TRANSFER) invokes a pair of menus which allow the user to clear, save, and restore data in the amplifier memory.

The first of these, the MEMORY CARD OPERATIONS menu is used to transfer part information between the 715 memory and an external memory card plugged into the slot on the front of the unit below the keyboard (see illustration). This is the first menu displayed when F4 is pressed.

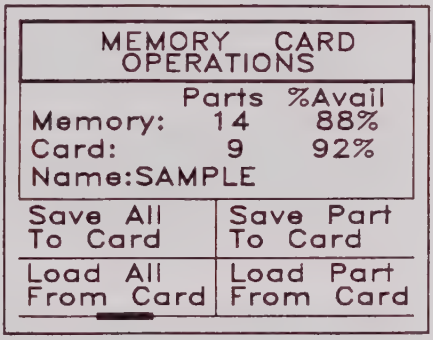


The second, the MEMORY & CARD INITIALIZATION menu, is used to clear the unit memory, clear the unit memory and load it with a database describing a small default set of generic parts, or clear the memory card. This menu is accessed by pressing MORE while displaying the MEMORY CARD OPERATIONS menu

Whenever either of these two menus is invoked, the unit first tests to determine if a memory card is plugged into the system. If a card is present, the full menu called for is displayed; if no card is present,

an abbreviated version of the menu called for is displayed. This abbreviated version is identical to the full menu, except that it omits all operations relating to the memory card, and instead reports the absence of the card.

Memory Card Operations (full menu)



This menu is used to transfer part information between the card and the system memory. The user can select either ALL (complete database) or PART (data on a single part), and can control the direction of transfer: SAVE (gage amplifier to card), or LOAD (card to gage amplifier).

An ALL transfer is an overwrite operation, erasing all previous data in the destination prior to the transfer; a PART transfer is nondestructive, simply adding the selected part to the existing database in the destination.

When copying the data on a single part, it is necessary to identify which particular part at the source is to be copied. If either of the PART transfers is selected, the system will automatically display a list of the parts currently in the sourcedatabase; selecting a part from this list will allow the system to proceed with the transfer.

Memory and Card Status

Along with the menu prompting for a choice of part data transfer operations, the 715 displays a status report on the unit memory and the data card currently in the slot. For the unit memory, it reports the number of parts currently defined, and what percent of the memory is empty and available for more part definitions and data. For the memory card it reports the same statistics reported for the unit memory: the number of parts defined on the card, and the percent of the card memory still available for more definitions/data, and also displays the name currently assigned to this card.

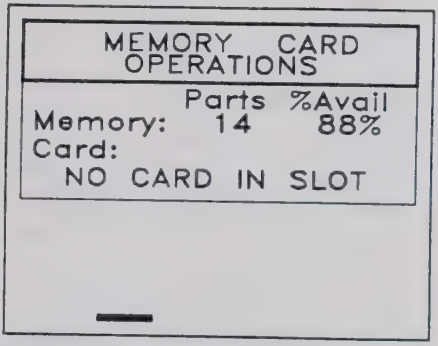
It is possible to assign a new name to the card in the slot at any time, by pressing the function key to the left of the card name (F2). The menu will then prompt for the new card name by replacing the current name on the screen with a line of underscores. Enter the new name, using the SHIFT key, and then press ENTER.

If an incorrect character is accidentally pressed while entering the new name, it can be erased by pressing the CAN (CANcel) key. Pressing CAN when the cursor is at the first position cancels the name entry operation, leaving the name as before.

Four memory transfer operations are available for selection: SAVE ALL TO CARD, LOAD ALL FROM CARD, SAVE PART TO CARD, and LOAD PART FROM CARD. The operation to be performed is selected by pressing the function key, F3, F4, F7, or F8, next to the name of the operation.

Memory Card Operations (abbreviated menu)

This is the menu displayed if no memory card is present. Since, in the absence of a card, no transfers are possible, none of the four SAVE and LOAD operations are offered.



Memory Status

The status of the unit memory is displayed, as in the full menu, but in the absence of a memory card, the 715 cannot report either the card status or the card name. Instead, a NO CARD IN SLOT message is displayed, to inform the user of this condition.

Memory Transfer Operations

The functionality of the four memory transfer operations offered by the full menu is as follows:

SAVE ALL TO CARD (F3)

Selecting this option causes all data previously on the card to be erased, and replaced by the complete part definition and data information in the unit memory. Before the operation is actually performed, a screen is displayed warning that all data on the card will be lost, allowing the operator to either cancel the operation and return to the MEMORY CARD OPERATIONS menu, by pressing PREV, or allow the operation to

proceed, by pressing F3. If the operator chooses to proceed, the clear/transfer is performed, and completion is reported on the screen. The operator is then prompted to return to the MEMORY CARD OPERATIONS menu by pressing PREV.

LOAD ALL FROM CARD (F4)

Selecting this option causes all data previously in the unit memory to be erased, and replaced by the complete part definition and data information on the data card. Before the operation is actually performed, a screen is displayed warning that all data in the memory will be lost, allowing the operator to either cancel the operation and return to the MEMORY CARD OPERATIONS menu, by pressing PREV, or allow the operation to proceed, by pressing F3. If the operator chooses to proceed, the clear/transfer is performed, and completion is reported on the screen. The operator is then prompted to return to the MEMORY CARD OPERATIONS menu by pressing PREV.

SAVE PART TO CARD (F7)

Selecting this option causes the complete record of one part, both definition and measurement data, to be copied from the unit memory to the data card. First a PART SELECTION menu is displayed, to allow the user to select which of the parts in the unit memory is to have its definition & data copied. If more parts are defined than can be listed on a single screen, the first four will be shown. Pressing MORE will cause the next four to be shown, then the next four, etc, until the last reached, at which point the message "End of List" will be displayed. The part to be copied is selected by pressing the function key next to it when its number & name is displayed on the screen. As soon as the part is selected, the copy operation is performed, and a message so stating displayed on the screen. None of the part records previously on the data card are changed, the part definition/data copied over is simply added to the end of the list.* If there is no room on the card for any more part definitions/data, the copy operation is not performed, and a message indicating this, and the reason therefore, is displayed on the screen.

LOAD PART FROM CARD (F8)

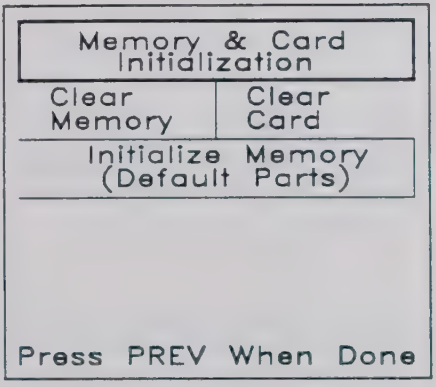
Selecting this option causes the complete record of one part, both definition and measurement data, to be copied from the data card to the unit memory. First a PART SELECTION menu, is displayed, to allow the user to select which of the parts on the

data card is to have its definition & data copied. If more parts are defined than can be listed on a single screen, the first four will be shown. Pressing MORE will cause the next four to be shown, then the next four, etc, until the last is reached, at which point the message "End of List" will be displayed. The part to be copied is selected by pressing the function key next to it when its entry is displayed on the screen. As soon as the part is selected, the copy operation is performed, and a message so stating displayed on the screen. None of the part records previously in the unit memory are changed, the part definition/data copied over is simply added to the end of the list.* If there is no room in the unit memory for any more part definitions/data, the copy operation is not performed, and a message indicating this, and the reason therefore, is displayed on the screen.

*:This is a useful feature, allowing the creation of new part definitions which duplicate existing ones, with a minimum number of keystrokes

Memory & Card Initialization (full menu)

The MEMORY & CARD INITIALIZATION menu is used to perform three major operations: to clear the unit memory, to clear & then initialize the unit memory, and to clear the memory card.

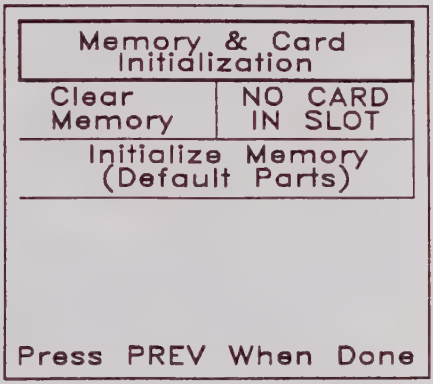


This menu is accessed by pressing MORE while displaying the MEMORY CARD OPERATIONS menu. Due to the major and irreversible effects of its operations, however, before the menu is displayed, an intermediate menu containing a warning to this effect is displayed, and the user prompted to press either F3 (to continue), or PREV (to return to the previous menu).

Two memory initialize and one card initialize options are available for selection: Clear Memory, Initialize Memory (Default Parts), and CLEAR CARD. The operation to be performed is selected by pressing the function key, F1, F2, or F5, next to its name.

Memory & Card Initialization (abbreviated menu)

This is the menu displayed if no memory card is present. Since, in the absence of a card, no CLEAR CARD operation is are possible, that option is not offered; instead, a NO CARD IN SLOT message is displayed, to in-form the user of this condition.



Initialization Operations

The functionality of the three memory and card initialization operations offered by the full menu is as follows:

Clear Memory (F1)

Clear Memory causes all part and characteristic descriptions and data in the Gage Amplifier to be erased.

Press F1 to cause this operation to be executed. A message will be displayed, reporting successful completion. Then press PREV three times to return to the main menu

After performing this operation, pressing SELECT PART from the MAIN menu will display an empty part list.

Calibration, range, and limit values are not affected by this operation.

This operation has no effect on any part or characteristic descriptions or data stored in the memory card (if any) currently inserted in the Gage Amplifier memory card slot.

INITIALIZE MEMORY (F2)

Initialize Memory causes all part and characteristic descriptions and data in the Gage Amplifier to be erased, and then loads a default part set of three generic parts, two with a single characteristic and one with two. For information on this default part set, see **Appendix B - Default Part Set**.

Press F2 to cause this operation to be executed. Two messages will be displayed, the first reporting successful completion of the erase operation, and the second, the successful loading of the default part set. Then press PREV three times to return to the main menu

After performing this operation, pressing SELECT PART from the MAIN menu will display a part list consisting of these three default parts.

Calibration, range, and limit values are not affected by this operation.

This operation has no effect on any part or characteristic descriptions or data stored in the memory card (if any) currently inserted in the Gage Amplifier memory card slot.

CLEAR CARD (F5)

Clear Card causes all part and characteristic descriptions and data recorded on the memory card currently inserted in the memory card slot to be erased.

Press F5 to cause this operation to be executed. A message will be displayed, reporting successful completion. Then press PREV three times to return to the main menu

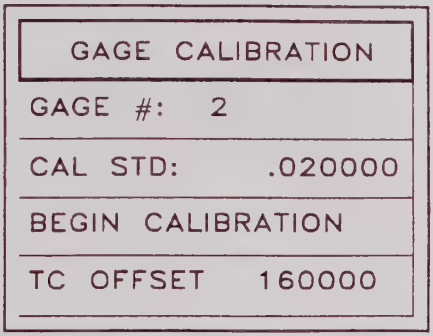
This operation has no effect on any part or characteristic descriptions or data stored in the Gage Amplifier system memory; only the memory card is affected.

Calibration, range, and limit values stored on the memory card are not affected by this operation.

CALIBRATE PROBES (F5)

In order to achieve all the accuracy that the Starrett gages are capable of, it is necessary to measure their output voltage at two different points a known physical distance apart. Using this data, the 715 can calculate a scale factor which can be applied to the gage output during use. This must be done for each gage, and is known as calibration.

Selecting CALIBRATE PROBES (F5) displays a menu which allows the user perform this calibration operation. This menu allows the user to specify the gage to be calibrated (F1) or the physical distance between the two calibration points (F2), to enter a new TCO (Temperature Compensation Offset) parameter (F4), or to display a second, tutorial menu which describes the exact calibration procedure to be followed (F3).



Pressing F1 causes the GAGE CALIBRATION menu to prompt, in the window adjacent to the function key, for the number of the gage to be tested. The gage is selected by pressing the appropriate numeric input key, 1, 2, 3, or 4, and then ENTER.

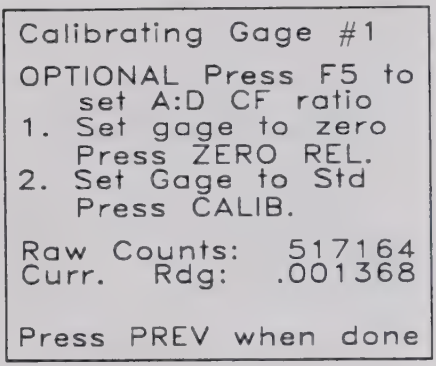
Pressing F2 causes the menu to prompt, in the window adjacent to the function key, for the distance between the two calibration points. The number, which can be either positive or negative, is entered using the keys for the ten numeric digits (0 ... 9), the decimal point (.), and the minus sign (−), and then ENTER.

Pressing F4 causes the GAGE CALIBRATION menu to prompt, in the window adjacent to the function key, for a TCO value, a decimal fraction in the range ±0.999999 to be used as an offset during temperature compensation.
The TCO is different for each Gage Amplifier. The correct value for each unit is determined at the factory, and entered into its memory, and recorded in printed form on a label attached to the underside of the unit. **The TCO should NOT be changed unless the value displayed differs from the value printed on this label. If it does differ, then it MUST be changed to the value shown on the label.**

After pressing F4, the new TCO value is entered, exactly as shown on the label, by pressing keys for the ten numeric digits (0 ... 9), the decimal point (.), and the minus sign (−).

The TCO is set to a default value of 0.160000 whenever the system is powered up from a cold start. This is a nominal value only, but will allow the unit to function, albeit with less than optimal temperature compensation, until properly warmed up and calibrated.

Pressing F3 displays a screen which identifies the gage being calibrated, plus instructions for performing the actual calibration operations.



Calibration Operations

Two types of operations are described: Setting up the A-to-D converter, and entering the two data points necessary for the unit to identify the zero point and compute the scale factor.

Coarse-to-Fine Ratio

One operation, using F5, causes the Gage Amplifier to recalculate the coarse-to-fine ratio for the A-to-D converter, the circuit which converts the probe output signals into digital information which can be displayed and stored.

Pressing F5 initiates the calculation, switching to a window which displays the progress of the operation. When calculation is complete (approximately 2 seconds), the system switches back to the instruction window.

This operation is performed automatically on a "cold" start, to make the system functional, but should be done again, once the system temperature has stabilized, prior to any probe calibration.

Zero Point and Scale Factor

The second operation, using ZERO REL and CALIB, causes the Gage Amplifier to calculate the offset and scale factors for the gage whose number was shown at the top of the screen.

The procedure for calculating the offset and scale factors is as follows:

1. The gage is set to the mechanical zero point, and the input captured by pressing ZERO REL. This establishes the first of two data points.
2. The gage is then set to the known physical offset from zero, and that input captured by pressing CALIB. This establishes the second data point.

The Gage amplifier then uses the inputs from the gage at the two data points, and the CAL STD value displayed in the GAGE CALIBRATION window to compute the zero point and scale factors appropriate to this probe.

Before storing the factors, the unit tests to determine if the two data points differ by an acceptable amount. If the two data points are sufficiently different, the calculated factors are stored, and the message Calibration Complete is displayed. If the data points are the same, or so nearly the same as to be suspect, the factors are discarded, and the message Calibration out of Range - Check Procedure is displayed. This check is necessary to ensure that the calibration procedure has been correctly followed; if the operator were to neglect to change physical standards between pressing ZERO REL and CALIB, the calculated scale factor would be so large as to cause improper Gage Amplifier operation, requiring a complete restart.

Calculation of offset and scale factors is not performed automatically on a "cold" start; instead default values, approximately correct for the Starrett ±.02" Linear Probe (Starett Part # 715-2Z) are stored. These are nominal values only, but will allow the unit to function, albeit with less than optimal accuracy, until properly warmed up and calibrated as part of the setup procedure for performing tests.

When calibration of a gage is complete, pressing PREV will return you to the MAIN menu. If another gage needs to be calibrated, press F5 to reenter the GAGE CALIBRATION window, select a new gage number (and, if necessary, a new CAL STD), and repeat the procedure. A separate calibration operation is required for each input which has a probe attached.

The scale factor for a probe input, calculated during this calibration, remains valid after rezeroing the gages during display mode, with either ZERO REL or ZERO ABS, and is retained in the 715 memory as long a power from the converter or batteries is available. New calibration is only required if the batteries are allowed to completely discharge, or if new gages, with different scale factors are connected to the unit.

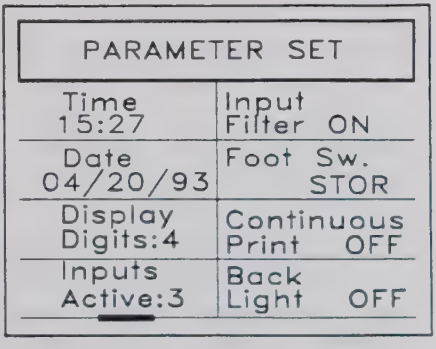
PARAMETER SET (F6)

The Gage Amplifier has a number of parameters relating to data display, operating modes, and test environment which can be controlled by the user. These parameters, which are independant of the curent gage amplifier data base or the particular part being tested, are controlled from a pair of PARAMETER SET menus.

Selecting PARAMETER SET (F6) displays the first of these menus; subsequently pressing MORE displays the second.

First PARAMETER SET Menu

The first PARAMETER SET menu allows the user to set the system time and date (F1 and F2), to control the precision of the numeric displays (F3), to specify how many gage inputs are active (F4), to turn the input filter on and off (F5), to control the foot switch action (F6), to turn continuous print mode on and off (F7), and to turn the screen back light on and off (F8).



Time

This parameter displays the current setting of the 715 internal real-time clock, and allows it to be changed. When the Parameter Setting menu is selected (either by being called from the MAIN menu or by toggling over from **RUN** mode), the value of the real-time clock at that time is captured and displayed. This display remains static while the menu is displayed, although the clock itself continues to increment. Pressing RUN/SETUP twice, to toggle over to **RUN** mode and back will cause the displayed time to be updated.

The real-time clock keeps military time, counting 24 hours from midnight to midnight, and not returning to 00 at noon. The time is shown in the form: HH : MM,

where HH represents the hours (00 to 23) and MM the minutes (00 to 59).

When function key F1 is pressed, the user is prompted for a new time to be set into the clock (*). The date is entered hours first, and then minutes, separated by a decimal point. After entering the new time, pressing ENTER causes the new time to be accepted and copied into the real-time clock.

Date

This parameter displays the current setting of the 715 internal calander, and allows it to be changed. When the Parameter Setting menu is selected (either by being called from the MAIN menu or by toggling over from **RUN** mode), the then-current value of the 715 internal calander is captured and displayed. This display remains static while the menu is displayed, although the calander itself continues to increment. Pressing RUN/SETUP twice, to toggle over to **RUN** mode and back will cause the displayed date to be updated.

The date is shown in the form: MM / DD / YYYY, where MM represents the month (01 to 12), DD the day (01 to 31), and YYYY the year (e.g.: 1993).

When function key F2 is pressed, the user is prompted for a new date to be set into the calander (*). The date is entered month first, then day, and then the last two digits of the year (e.g.: 93), with the three fields separated by decimal points. After entering the new time, pressing ENTER causes the new date to be accepted and copied into the calander.

(*): Note that setting the date overwrites the recorded time value, causing it to be lost. Therefore, if both the date and the time are to be set, the date must be set first.

Display Digits

This parameter controls the number of digits shown when displaying the Gage output on a display screen. From 0 (sign only) to 6 digits of precision can be displayed. When function key F3 is pressed, the user is prompted for a single digit numeric digit. After entering the digit, press ENTER to store it and return to the Parameter Select menu. A value larger than 6 will be ignored, and the previous value of the parameter will not be changed. The number displayed when exiting the menu via the PREV key

will be the one in effect from that point on.

The default value for this parameter (that is, the value which is loaded when the unit is initialized) is 5

Inputs Active

This parameter controls the number of input channels which the Gage Amplifier will sample and display. If set to 4, all four channels will be sampled and displayed; if set to 3, only channels 1, 2, and 3, etc. The meter(s) for the unused channel(s) will continue to be displayed, but the input(s) for those channel(s) will not be sampled, and the meter display will not be updated.

The rate at which inputs are sampled and displayed is directly related to the number of active channels: the more active channels, the more time to sample them and the slower the sampling rate. It is therefore to the user's advantage to only have active as amny channels as are actually being used; all others should be made inactive.

When function key F4 is pressed, the user is prompted for a single numeric digit. After entering this digit, press ENTER to store it and return to the Parameter Select menu. A value larger than 4 will be ignored, and the previous value of the parameter will not be changed. The number displayed when exiting the menu via the PREV key will be the one in effect from that point on.

The default value for this parameter (that is, the value which is loaded when the unit is initialized) is 4

Input Filter

In certain applications, such as in the presence of vibration, or if making a measurement on a part rotating between centers, the probe will never be able to settle out completely, and the displayed gage input will exhibit a small amount of jitter. This will be more obvious in the numeric display, particularly when displaying with 5 or 6 digit precision.

The Gage Amplifier has an input filter which can be turned on to eliminate such jitter, at the expense of slightly slower response time. This filter, a low-pass exponential filter implemented as part of the data sampling function, applies to all four channels. It is not possible to turn it OFF for some channels and ON for others.

When function key F5 is pressed, the digital filter is toggled between OFF and ON. The choice displayed when exiting the menu via the PREV key will be the one in effect from that point on.

The default value for this parameter (that is, the value which is loaded when the unit is initialized) is OFF (no filtering)

Foot Switch

This parameter controls what action the 715 will take when the foot switch is pressed. The three options available are PRINT, STORE, and PRINT and STORE. Repeatedly pressing function key F6 cycles through the three choices, displaying them in succesion in the window adjacent to the function key.

The choice displayed when exiting the menu via the PREV key will be the option in effect from that point on.

The default value for this parameter (that is, the value which is loaded when the unit is initialized) is STORE

Continuous Print

The Gage Amplifier has the ability to choose between printing on command, when the PRINT key or the Foot Switch is pressed, or printing continuously, every time the data is sampled. This second alternative, Continuous Print, allows the operator to perform some optimization operation while observing the results on a printer output or display screen.

When function key F6 is pressed, the Continuous Print function is toggled between OFF and ON. The choice displayed when exiting the menu via the PREV key will be the one in effect from that point on.

The default value for this parameter (that is, the value which is loaded when the unit is initialized) is OFF

Back Light

In conditions of dim light, there may not be enough contrast to read the figures on the screen clearly. The 715 has the ability to illuminate the screen background to eliminate

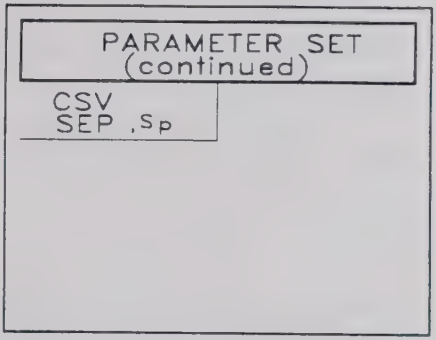
this problem if necessary. The BACK LIGHT parameter controls this background illumination. Pressing F8 toggles the light source between ON and OFF, indicating the resulting state in the window adjacent to the function key.

It is recommended that the back light only be turned on when necessary. Operating the unit continuously with the back light on will reduce the operating time between battery charges to approximately ??% of what could otherwise be expected.

The default value for this parameter (that is, the value which is loaded when the unit is initialized) is OFF

Second PARAMETER SET Menu

The second PARAMETER SET menu allows the user to control the format of the data stream sent to the printer during CSV output.



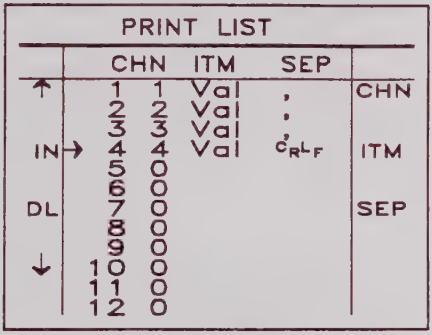
CSV Separator

This parameter allows the user to control one aspect of the CSV output format, specifically, the characters used to separate the date and time information from the values. Two choices are available: a comma followed by a space, or a space, followed by two colons, followed by a second space. Pressing function key F1 alternates between the two choices, displaying them alternately in the window adjacent to the key. The option displayed when exiting the menu via the PREV key will be the one in effect from that point on.

The separator between the data values is always a comma followed by a space, irrespective of which choice is in effect to separate the data from the time and date.

The default value for this parameter (that is, the choice which is loaded when the unit is initialized) is a comma followed by a space.

PRINT L(i)ST SELECTION (F7)



The Print List menu allows the user to select and format the data sent to the printer or remote display when performing a Print operation. Print operations can be initiated in three ways: by pressing the PRINT key, by pressing the foot switch (if so enabled); or by being in Continuous Print mode (if so enabled) (see **PARAMETER SET**, above, for details). The data sent can be specified to be any mix of measured values, statistical sampling derivatives, and computed functions of any or all of the channel inputs. The exact format of the displayed/ printed data can be specified, and both Column and SPC formats are supported.

The format of the output data is controlled by a set of instructions created by the user and displayed on the Print List menu. Each instruction defines on operand and/or format character to be sent to the display/printer; they are executed in sequence upon receipt of a print command, creating the formatted listing of the data selected.

The instructions are listed vertically in the window, with the first instruction to be performed at the top, the next immediately below that, and then the next , and so on, numbered in order of execution. The maximum number of instructions is 24, twice the number of lines for which there is room on the PRINT LIST screen.

Each instruction specifies an operand to be sent, and a separation character to follow; multiple instructions can send multiple operands, properly separated and formatted onto whatever number of lines is desired.The first 12 instructions are displayed initially, the other 12 are displayed by moving the instruction cursor off the screen to point to either instruction 13 or instruction 24. When a print operation is initiated, instruction execution begins withinstruction 1, then 2, etc., until either instruction 24 or an instruction containing a No Separator code (the "end of instructions" marker) is encountered, at which time the print operation is considered to be complete.

As an example, suppose it is desired to print the date and time, and the number of samples, on one line, the channel numbers on the next line, the raw channel data on the next line, and then the four channel value averages on the line below that, with . The set of instructions to accomplish this would be expressed on the PRINT LIST screen in the following form:

	CHN	ITM	SEP
1	X	Date	SP
2	X	.....	SP
3	X	Time	SP
4	X	.....	SP
5	X	N	□□
6	1	Chn#	,
7	2	Chn#	,
8	3	Chn#	,
9	4	Chn#	□□
10	1	Val	,
11	2	Val	,
12	3	Val	,
13	4	Val	□□
14	1	Avg	,
15	2	Avg	,
16	3	Avg	,
17	4	Avg	□□
18	X	.....	(blank)
19	X	XXX	XX

(**XX** = Don't Care)

This set of instructions would result in the following output on a printer (values shown are typical):

```
04/23/1993  11:03  307
1, 2, 3, 4
-.00542, -.01627,  .10536,  .02980
 .00036, -.01542,  .11676,  .01932
```

Entering/Editing a Sequence of PRINT Steps

The list of instructions is entered and modified by means of the seven function keys, F1 through F7 (F8 is not used). F1 and F4 are used to select a particular line in the list of instructions; F2 and F3 insert and delete instructions at the designated line; F5 through F7 specify an operand and separator to be printed.

↑ (F1) and ↓ (F4) move the pointer (located to the left of the list) up or down to select a particular line for action. Pressing ↑ moves the pointer up one line; Pressing ↓ moves it down.

IN (F2) and DL (F3) insert instructions into the list and delete them from it. Pressing F2 causes an empty instruction to be inserted in the list at the location indicated by the pointer; the instruction previously there, and all instructions below it, are each moved down one to make room for this new instruction, and the bottom instruction is lost. Pressing F3 causes the instruction at the location indicated by the pointer to be deleted; all instructions below are moved up by one to fill the vacancy, and an empty instruction is inserted on the bottom of the list. An empty instruction is an instruction with a channel number (CHN) of 0, a blank item (ITEM) field, and a blank separator (SEP) field

Operands

CHN (F5) and ITM (F6), operating jointly, specify the operand, if any, to be printed by this instruction. CHN (F5) selects the channel whose input or statistic is to be used for the operand in the selected step; pressing this key repeatedly steps through the four channels, round-robin style until the desired channel number is displayed. ITM (F6)

selects type of channel function or operand to be used; pressing this key repeatedly steps through the possible choices, round-robin style until the desired function is displayed. The function selected by F6 can be the raw channel input, one several statistical sampling derivatives of the channel input, the math function defined for that channel (see Math Function, called from the MAIN menu), or any of several system status items which it may be desirable to print. The different functions and operands which can be selected are:

[Val]	Value	The measured value of the specified channel input.
[Max]	Maximum	The maximum sampled value on the specified channel since the beginning of sampling.
[Min]	Minimum	The minimum sampled value on the specified channel since the beginning of sampling.
[TIR]	Total Indicated Runout	The difference between the maximum sampled value and the minimum sampled value on the specified channel since the beginning of sampling.
[Avg]	Average	The average of all sampled values on the specified channel since the beginning of sampling.
[N]	Samples	The number of times the specified channel has been sampled since the beginning of questioning.
[Math]	Math Function	The result of the curently specified mathematical function for the specified channel.
[Stat]	Limit Status	The status, relative to the upper and lower limits, of the measured value on the specified channel. If the value is above the upper limit, the ASCII string "OVER" will be sent; if under the lower limit, the ASCII string "UNDER" will be sent. If the value is between the two limits, an ASCII string of Spaces will be sent.

[Time]	Time	The current time, as determined by the Gage Amplifier real-time clock, expressed in HH:MM format, where HH is the time in hours for a 24 hour day, and MM is the time in minutes.
[Date]	Date	The current data, as determined by the Gage Amplifier real-time clock, expressed in MM/DD/YYY format, where MM is the month, DD the day, and YYYY the year.
[Chn #]	Channel Number	The channel number of the specified channel.
[(blank)]	(No Operand)	No operand is printed. This code allows multiple separators to be printed without an intervening operand.

As an example of how CHN and ITM work together, pressing F5 until channel 2 is selected, and then pressing F6 repeatedly to select Avg, will result in an operand specification of "2 Avg", meaning "The average of all sampled values on channel 2 since the beginning of sampling".

It is not possible to print out fixed constant operands.

Separator Codes

SEP (F7) selects one or more separator characters to be sent to the printer after the operand. Nine separators are available (ten, if [no separator] is included). They are:

[,]	Comma
["]	Quotation Mark
[▭]	Carriage Return (but no Line Advance); returns to the beginning of the current line)
[▭▭]	Carriage Return & Line Advance; advances to the beginning of the next line
[SP]	Space
[SP]	Space, followed by a Comma.
[SP "]	Space, followed by a Quotation Mark
[" , "]	Quotation Mark, followed by a Comma, followed by a Quotation Mark
[" ▭]	Quotation Mark, followed by a Carriage Return; prints a Quotation Mark, and then returns to the beginning of the current line.
[(blank)]	Blank (= no separator); terminates the print operation

MATH ENTRY (F8)

When taking a measurement and storing the data, the 715 has the ability to perform data reduction calculations on the raw data, and store the results of these calculations in the place of the data, on a channel-by-channel basis.

MATH ENTRY invokes a pair of menus for specifying up to four separate functions and defining the mathematical operations to be performed by each.

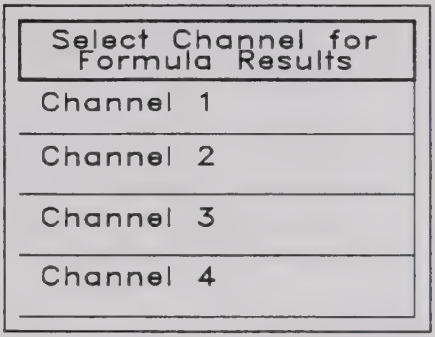
Selecting a Channel

The first menu displayed is SELECT CHANNEL. This menu allows the user to iden-

tify a which of the four functions is to be displayed/defined/changed. The channel (function) is chosen by pressing the function key (F1 through F4) to the left of the

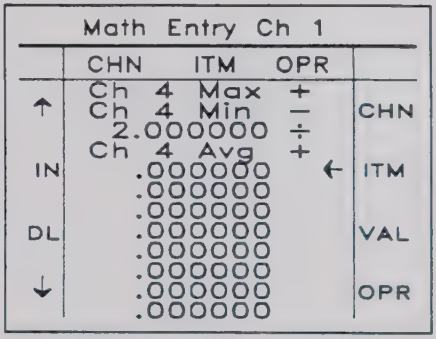
display screen. Once the channel is selected, a second menu for specifying the formula, will be displayed, with the name MATH ENTRY CH [n] (n = the selected channel) at the top.

Since it is not useful to define more math functions than there are characteristics of the current part, if the operator attempts to do so he will be prompted by a message telling him to define more characteristics.



Math Entry

Once a math channel (function) has been selected, a second menu, MATH ENTRY, will be displayed. This second menu defines the formula to be used in calculating the function. The formula is shown as a list of steps, to be executed in order, each step defining an operand and an operation to be performed. The steps are shown listed vertically in the window, with the first step to be performed at the top, the next immediately below that, and then the next , and so on. The maximum number of steps in a formula is 12, the number of steps for which there is room on the MATH ENTRY screen.



Each step specifies an operation to be performed on an accumulated result, which, after the last step of the formula, is the final result of the calculation. Each time the calculation is begun, starting at the first (top) step, this accumulated result is to a starting value of 0. The formula need not use all twelve steps; a step in which (No Operation) is specified is taken as an "end of formula" marker, and causes the accumulated result created by the previous steps to be stored.

As an example, the formula: **(Max - Min) ÷ 2) + Avg**, using the parameters of channel 4 as inputs, would be expressed on the MATH ENTRY screen in the following form:

CHN	ITM	OPR
Ch 4	Max	+
Ch 4	Min	–
2.000000		÷
Ch 4	Avg	+
XXXXXXXX		....

Inserting a left parantheses causes the system to save the current accumulated result, and start a new one, initialized to a selected value, whose contents will represent the accumulated result of all subsequent steps until a right parantheses is inserted. When this occurs, this new accumulated result is used as an operand on the accumulated result, and the result restored as the accumulated result to be used thereafter.

An example of the use of parantheses would be the formula: **(Max-Min) × (Avg + 3)**, using the parameters of channels 2 and 3 as inputs. This formula would be expressed on the MATH ENTRY screen in the following form:

CHN	ITM	OPR
Ch 3	Max	+
Ch 4	Min	–
Ch 2	Avg	(
3.000000		+
)		X
XXXXXXXX		....

(In the above two examples, **XXX** = Don't Care, and **....** = Blank. The selection of input operands [from channels 2, 3, & 4] is for the purpose of example only.)

Entering/Editing a Math Formula

The list of steps is entered and modified by means of the eight function keys, F1 through F8. F1 and F4 are used to select a particular step in the list; F2 and F3 insert and delete steps at the selected step; F5 through F8 specify the operand and operation for the selected step.

↑ (F1) and ↓ (F4) move the pointer (located to the right of the list) up or down to select a particular cell for action. Pressing ↑ moves the pointer up on step; Pressing ↓ moves it down.

IN (F2) and DL (F3) insert steps into the list and delete them from it. Pressing F2 causes an empty step (a step with a fixed-constant operand equal to ZERO and a blank [= No Operation] operation field) to be inserted in the list, at the location indicated by the pointer; the step previously there, and all steps below it, are each moved down one to make room for this new step, and the bottom step is lost. Pressing F3 causes the step at the location indicated by the pointer to be deleted; all steps below are each moved up one to fill the vacancy, and an empty stepis inserted on the bottom of the list.

CHN (F5), ITM (F6), and VAL (F7) specify the operand, if any, to be used in the currently selected step.

Channel Operands

If the operand is to be a channel input, or one of the statistical sampling derivatives of a channel input, such as AVG, or MIN, etc., then ITM (Item) and CHN (Channel), working together, will define it.

CHN (F5) will identify which of the four channels whose input or statistics are to be used for the step. Pressing this key repeatedly steps through the four channels, round-robin style until the desired channel number is displayed.

ITM (F6) will select type of channel function to be used. It can be the raw channel input, or one of the statistical sampling derivatives thereof. Pressing this key repeatedly steps through the possible choices, round-robin style until the desired function is displayed. The different channel functions operands which can be selected are:

[Val]	Value	The measured value of the specified channel input.

[Max]	Maximum	The maximum sampled value on the specified channel since the beginning of sampling.
[Min]	Minimum	The minimum sampled value on the specified channel since the beginning of sampling.
[Avg]	Average	The average of all sampled values on the specified channel since the beginning of sampling.
[N]	Samples	The number of times that data has been sampled since the beginning of sampling.
[Math]	Math Function	The result of the curently specified mathematical function for the specified channel. (*) (*): Note that the channel number used with this function must be different than the channel for which the calculation is currently being defined)
[ )]	Current Value	The current accumulated value. When this operand is specified, the operation specified by OPR applies it to the previously saved accumulated value, and the result of that operation replaces the current accumulated value, which is discarded.

As an example of how ITM and CHN work together, pressing F5 until channel 3 is selected, and then pressing F6 repeatedly to select Max, will result in an operand specification of "Ch 3 Max", meaning "The maximum measured value of channel 3 since the beginning of sampling".

Fixed Constant Operands

If, instead of a function, the specified operand is to be a fixed constant, it is entered from the keypad, after pressing VAL (F7). The selected step will prompt the user for a

value with a line of UNDERSCORE characters (_ _ _ _ _); the value, which can be positive or negative, is entered using the keys for the ten numeric digits (0 ... 9), the decimal point (.), and the minus sign (−). Note that when entering an integer, it is necessary to follow it with a decimal point; if this is not done, the digits entered will be treated as an entry into the least significant digits displayed on the screen]. When the data has been correctly entered, pressing the ENTER key will cause it to be accepted and stored in memory. Pressing ENTER when the cursor is at the first position enters a value of ZERO for the data.

If an incorrect character is accidentally entered, it can be erased by pressing the CAN (CANcel) key. Pressing CAN when the cursor is at the first position cancels the value entry operation, returning the data to its original value.

Operation Codes

OPR (F8) selects the operation to be performed by the currently selected step. Ten operations are available (eleven, if [no operation] is included). These operations are:

[( ]	Open Parentheses	Stores the present accumulated value, and starts a new one, using the specified operand as the initial value.
[+]	Plus	Adds the specified operand to the accumulated value.
[−]	Minus	Subtracts the specified operand from the accumulated value.
[×]	Multiply	Multiplies the accumulated value by the specified operand.
[÷]	Divide	Divides the accumulated value by the specified operand.
[^{2}]	Square	Takes the square of the accumulated value. The specified operand is ignored

[√]	Square Root	Takes the square root of the accumulated value. The specified operand is ignored
[LO]	Minimum	Takes the Minimum of: the accumulated value and the specified operand
[HI]	Maximum	Takes the Maximum of: the accumulated value and the specified operand
[| |]	Absolute Magnitude	Takes the absolute value of the accumulated value. The specified operand is ignored
[ ]	(No Operation)	Terminates the calculation, reporting the accumulated value as the final result.

CALIBRATION AND ACCURACY

General Considerations

The Model 715 Electronic Gage Amplifier is specified to have an accuracy of 0.2% of the probe travel when properly calibrated, and operating in a 68° F environment. Using the Starrett No. 715-2Z 0.04" travel linear probe, it is thus possible to achieve repeatable accuracies of ± 0.000080 inches.

In order to achieve this accuracy, however, careful attention should be paid to the environmental and calibration information given in this section. As with any precision measuring device, regular calibration, performed as directed, is essential, as is using the instrument under the proper conditions and in the proper manner.

Operating Environment

The Model 715 Electronic Gage Amplifier is designed to be operated in a test or inspection laboratory environment, and, as such, should not be used on the manufacturing floor. "Clean Room" standards are not necessary, but the following guidelines should be adhered to:

Temperature

The temperature of the area where the unit will be used should be controlled to keep it in the range 68±5° F (20±3° C). The more closely this temperature can be controlled, the better the attainable accuracy of the resulting measurements.

Water, Oil, and Dirt

The Gage Amplifier should not be exposed to water, oil, or dirt beyond what would reasonably be expected to prevail in a test environment.

Calibration

To achieve full rated accuracy with the Gage Amplifier (0.2% of the probe range) it is necessary for the unit/probe combination to be properly calibrated initially, and at regular intervals thereafter. The following guidelines should be adhered to:

Initial Calibration

Initial calibration is required whenever the Gage Amplifier batteries have been allowed to fully discharge (as signaled by the message MEMORY CLEARED - DEFAULT LOADED on the startup screen), or if a CLEAR MEMORY or INITIALIZE MEMORY operation has been selected from the MEMORY & CARD INITIALIZATION menu. It is also required whenever one or more new probes is installed on the unit in preparation for a new test. The following procedure should be followed to perform an initial calibration:

1 Place the Gage Amplifier in the environment where it will be used, and allow it to stabilize it temperature in that environment for a minimum of 1½ hours. If the batteries are not fully charged up, connect to the AC adaptor and allow to charge up overnight (see **Battery Charging**, below).

2 The first step of the calibration procedure is to determine that the temperature compensation offset (TCO) stored in the unit memory has not been changed and is still correct. The stored value of this parameter is shown in the GAGE CALIBRATION menu; compare this displayed value with the value printed on the label on the underside of the unit. If they do not agree, press F4 and enter the value shown on the menu.

3 The next step is to tell the unit to compute the coarse-to-fine count ratio for the A-to-D converter. This is done by pressing F5 while displaying the CALIBRATION OPERATIONS menu.

4 After this, each of the probes should be calibrated separately, and their Offset and Scale Factors determined, using the GAGE CALIBRATION and CALIBRATION OPERATIONS menus.

At this point, the unit can be considered to be properly calibrated.

The procedures for performing each of these operations are described earlier in this manual; see MENUS - CALIBRATE PROBES (Calibration Operations), for details.

Battery Charging

The battery charging circuit in the Gage Amplifier has two operating modes, full charge, for when the batteries are charging up, and trickle charge, for when they are fully charged and need only to have their charge maintained. Full rated accuracy cannot be achieved while in full charge mode; the heat, however slight,which accompanies the charging up process precludes the uniform internal temperature necessary for the temperature compensation logic to operate correctly.

When the batteries are fully charged, or when the unit is not connected to the AC adaptor but is running off batteries, charge up heat is not a problem, and full rated accuracy is attainable

Before calibrating or using the unit, make sure that the batteries are fully charged. If the batteries have been allowed to even partially discharge, the unit should be connected to the power unit and left overnight. By the next day the batteries will be fully charged, and calibration can proceed.

Calibration During Use

Having once been charged up and calibrated as described above,the Gage Amplifier will retain its calibrated accuracy for a long period without further action being required. Whether the unit is turned off or left on will not affect its accuracy, as long as the batteries are charged, and the unit is kept in an environment as described above.

It is recommended, however, that a full calibration procedure be performed at least once a month, to ensure that full rated accuracy is not compromised in any way.

The procedure to be followed for this recalibration is the same as that described above inder **Initial Calibration.**

Temperature Compensation

To maintain specified accuracy over the full operating temperature range, the 715 is equipped with logic to compensate for temperature-induced changes in the probes and sensing circuits. This logic keeps a record of the temperature at which each channel was last calibrated, and uses the difference between that temperature and the current temperature to calculate a correction factor to be applied to the current reading on that channel.

Disabling/Enabling Temperature Compensation

If the unit memory is initialized, whether by undergoing a "cold" start, or as a result of operator action, all data in the memory, including the recorded calibration temperatures described above is lost, preventing the temperature compensation logic from functioning properly. In order to prevent erroneous readings as a consequence, whenever the unit is initialized, the temperature compensation is turned of for all four channels.

This does not prevent the unit from working. Any probes which are attached can be used, applying the nominal zero offsets and scale factors loaded during initialization, but accuracy is limited, and the unit should not be used for precise measurements.

The act of calibrating the probes reenables temperature compensation. As each of the four probes is calibrated, the calibration temperature for that probe is recorded, and the temperature compensation for that probe turned back on. When all four probes have been calibrated, temperature compensation is once again fully operational.

Temperature Compensation Offset

For maximum accuracy, the Model 715 Gage Amplifier requires that a parameter, specific to each unit, be stored in its memory. This number, which has a range of ±0.999, is used by the unit temperature compensation logic to achieve rated accuracy over the full operating temperature range.

The proper value for this parameter, called the TCO (Temperature Compensation Offset), is determined at the factory for each unit, and placed in its memory prior to shipment. This value is printed on a label located on the bottom of the case, thus:

TCO = ± 0.nnn

Under ordinary circumstances it should never be necessary to reenter or change this parameter. The system batteries, when fully charged, are capable of supporting the memory for more than two months when the unit is turned off, so as long as the unit is left plugged in over night at least once a month, this will never be lost.

The TCO value can be accidentally changed to an incorrect value under certain circumstances. A "cold" restart, whether resulting from fully discharging the batteries, or forced from the keyboard, will replace the stored value with a default value of +.160 during the initialization procedure. A LOAD ALL FROM CARD using a memory data card which was written on a different unit will replace the first unit's TCO with that of the other.

For whatever reason, if the TCO is changed, it will be necessary to reload the correct TCO for this unit. To do this, follow the procedure described in the section **MENUS - CALIBRATE PROBES**, elsewhere in this manual.

Other Factors Affecting Accuracy

It is possible to gain a slight improvement in Gage Amplifier accuracy by operating the unit from a regulated power supply, instead of the AC adaptor supplied with the unit. The voltage required are 7.5 volts, with a maximum required current of 350 mA.

Accuracy can also be improved slightly by allowing 5 or 10 seconds for the reading to stabilize after placing the part under the probe before storing or recording it. As in all electronic devices, voltages and signals tend to approach their final values exponentially; by waiting these few extra seconds, the user can be certain that the measurement has reached the true value.

APPENDIX A - INTERFACES

Probe Interfaces

The 715 is equipped with multiple probe inputs, to allow the connection of up to four gage probes to the unit. These interfaces consists of 6-position Micro-DIN shielded receptacles which will accept a Micro-DIN shielded plug. The pin assignments on these receptacles are as follows:

Pin	Signal
1	– SIGNAL
2	BIAS
3	+ SIGNAL
4	GROUND
5	AC DRIVE
6	GROUND

The following Starrett gage probes are suitable for use with this interface:

- ☐ Model 715-2Z ± 0.020" Linear Probe
- ☐ Model 715-1Z ± 0.020" Lever Probe

For other probe types and ranges, contact your L. S. Starrett representative

Serial Interface

The 715 is equipped with a serial I/O interface, to allow it to communicate with printers, CRT terminals, and computers. This interface consists of an RS232 serial port equipped with a DB-9 male connector. The pin assignments on this connector are as follows:

Pin	Signal
1	(nc)
2	RX
3	TX
4	DTR
5	GROUND
6	(nc)
7	RTS
8	(nc)
9	(nc)

Printers

The 715 can interface directly with a serial printer via this port, sending it whatever character string is specified by the print list program; only a unidirectional serial data cable (Starrett Part No. 60643) is required. Any ASCII serial printer which conforms to the interface criteria listed below should be fully compatible with the data collector in this configuration:

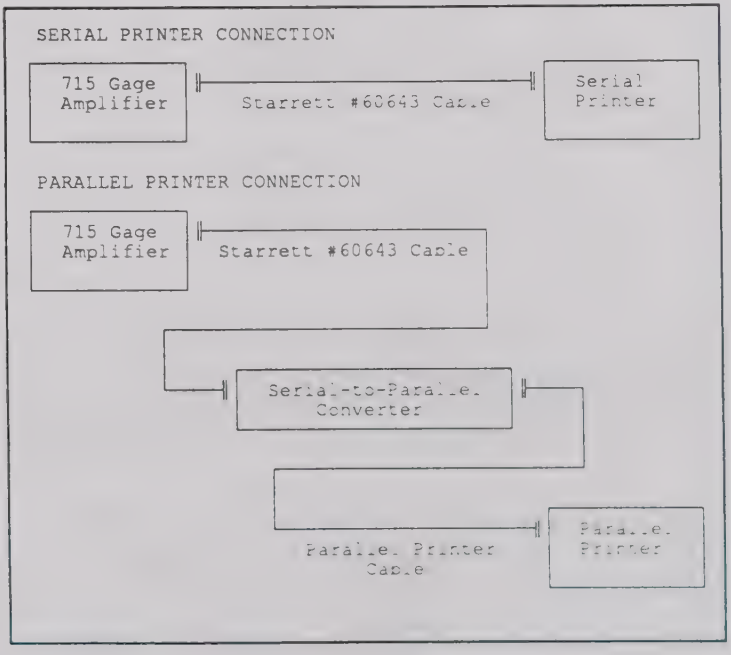
Input Connector:	DB-9 male connector
Data Format:	9600 Baud 8 Data Bits 1 Stop Bit No Parity
Handshaking Protocol:	XON/XOFF

Character Set:	IBM Proprinter® Compatible

For parallel printers, a commercially-available serial-to-parallel converter, and a second cable, to connect the converter to the printer, are also required. Any ASCII parallel printer which conforms to the interface criteria listed below should be fully compatible with the data collector in this configuration:

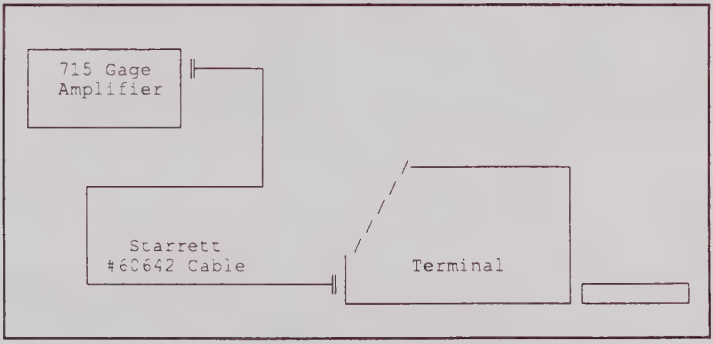
Data Rate:	9600 Baud
Handshaking Protocol:	XON/XOFF
Character Set:	IBM Proprinter® Compatible

Connection to either type of printer will be as shown in the figure below.



CRT Display Terminals

The 715 can interface directly with a CRT display terminal via this port, treating it both as an input and as an output device. Only a bidirectional serial data cable (Starrett Part No. 60642) is required. Any terminal capable of sending and receiving the ASCII character set in serial form should be fully compatible with the data collector in this configuration. Connection to the terminal will be as shown in the figure below.



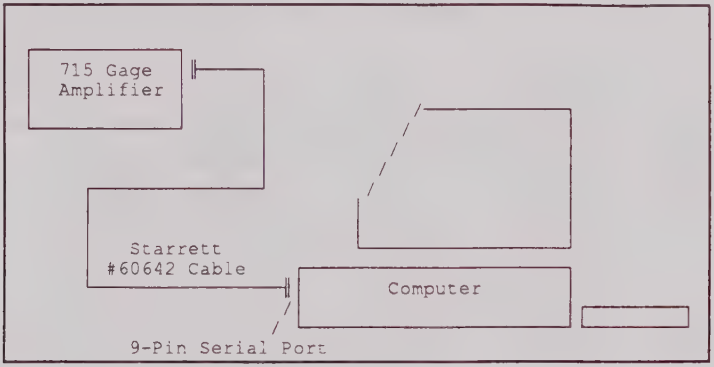
In this configuration, any data output by the Gage Amplifier as a result of a PRINT operation, a PART DATA REPORT, or an OUTPUT CHARACTERISTIC operation will be displayed on the terminal CRT screen, and any characters typed on the terminal keyboard will be acceped as input by the Gage Amplifier and acted upon as if they were the same functions/characters entered on the keyboard.

For a listing of the input codes which the Gage Amplifier will accept from a terminal, see the section, **Input Character Set**, below.

Computers

The 715 can interface directly with a computer via this port, treating it both as an input and as an output device. Only a bidirectional serial data cable (Starrett Part No. 60642) is required. Any computer capable of sending and receiving the ASCII character set in serial form should be fully compatible with the data collector in this configuration. Connection to the computer will be as shown in the figure on the facing

page.



Input Character Set

Control Codes

The input codes for the Gage Amplifier control functions are shown in the table on the following page. Not all codes will be acted upon in all cases; the subset of control functions which the unit will accept and act upon at any given time depends upon the mode it is in and the menu (if any) currently being displayed. For example, when displaying four meters in RUN mode, only the following function codes will be recognized:

RANGE ←	ZERO REL	STORE	GAGE
RANGE →	ZERO ABS	PRINT	1
IN/MM	-	RUN/SETUP	2
LIMITS		RESET DATA	3
			4

The two control functions RANGE ← and RANGE → share their codes with the two ASCII characters < and >. Since the RANGE ← and RANGE → operations can only be performed while displaying a meter in RUN mode, while > and < are only used as

characters in entered ASCII strings, there is no conflict.

Input Control Codes

CHAR	DEC	HEX
CAN(cel)	008	08
PREV	009	09
IN/MM	010	0A
ZERO ABS	011	0B
LIMITS	012	0C
ENTER	013	0D
RUN/SETUP	015	0F

CHAR	DEC	HEX
F1	016	10
F2	017	11
F3	018	12
F4	019	13
F5	020	14
F6	021	15
F7	022	16
F8	023	17

CHAR	DEC	HEX
MORE	024	18
ZERO REL	025	19
GAGE	026	1A
STORE	027	1B
PRINT	028	1C
RESET DATA	031	1F
RANGE ←	060	3C
RANGE →	061	3E

Data Codes

When entering a data string (i.e.: responding when the system is prompting with a string of underscores), the Gage Amplifier will accept and display any of the characters in the character set (a subset of the ASCII character set) shown in the table below and on the facing page.

It should be noted, however, that if the system is prompting for a numeric value (an upper or lower limit, for instance), any codes except those for the ten numeric digits, the decimal point and the minus sign should not be sent. Any other codes may cause their character to be displayed during entry, but will cause an indeterminate value to be stored when the code for ENTER is sent.

Input Data Codes

CHAR	DEC	HEX
(space)	032	20
!	033	21
"	034	22
#	035	23
$	036	24
%	037	25

CHAR	DEC	HEX
&	038	26
'	039	27
(	040	28
)	041	29
*	042	2A
+	043	2B

CHAR	DEC	HEX
,	044	2C
-	045	2D
.	046	2E
/	047	2F
0	048	30
1	049	31

Input Data Codes (continued)

CHAR	DEC	HEX
2	050	32
3	051	33
4	052	34
5	053	35
6	054	36
7	055	37
8	056	38
9	057	39
:	058	3A
;	059	3B
<	060	3C
=	061	3D
>	062	3E
?	063	3F
@	064	40
A	065	41
B	066	42
C	067	43
D	068	44
E	069	45
F	070	46
G	071	47
H	072	48
I	073	49
J	074	4A
K	075	4B

CHAR	DEC	HEX
L	076	4C
M	077	4D
N	078	4E
O	079	4F
P	080	50
Q	081	51
R	082	52
S	083	53
T	084	54
U	085	55
V	086	56
W	087	57
X	088	58
Y	089	59
Z	090	5A
[	091	5B
\	092	5C
]	093	5D
^	094	5E
_	095	5F
`	096	60
a	097	61
b	098	62
c	099	63
d	100	64
e	101	65

CHAR	DEC	HEX
f	102	66
g	103	67
h	104	68
i	105	69
j	106	6A
k	107	6B
l	108	6C
m	109	6D
n	110	6E
o	111	6F
p	112	70
q	113	71
r	114	72
s	115	73
t	116	74
u	117	75
v	118	76
w	119	77
x	120	78
y	121	79
z	122	7A
{	123	7B
|	124	7C
}	125	7D
~	126	7E

AC Adapter Interface

The 715 is equipped with an interface to allow battery charging/operation from an AC adaptor. This interface is an industry-standard coaxial power receptacle with the following pin assignments:

Pin	Signal
Outer Conductor	GROUND
Center Conductor	+ 7.5V DC (350 mA MAX)

Foot Switch Interface

The 715 is equipped with an interface to allow the connection of a foot-operated switch to control storing/printing of readings while leaving the operator's hands free. This interface consists of a 3.5 mm subminiature phone jack which will accept a mating phone jack. The pin assignments on this jack are as follows:

Pin	Signal
Shell	SWITCHED SIGNAL
Tip	GROUND

The foot switch used in this application (a normally-open, SPST switch, Starrett Model #720-3) can be obtained from your L. S. Starrett representative.

APPENDIX B - DEFAULT PART SET

The following is a description of the default set of three parts which the Gage Amplifier will load on "cold" start, or when an Initialize Memory operation is executed from the MEMORY AND CARD INITIALIZATION menu.

Part ID # 10

Part Number:
Description: Pt 10 1 Ch G1
Department:
Company:

Number of Characteristics: 1

Characteristic Data

Char ID # 11
Description: Ch 11 G Pt 1
Gage Identifier:
Subgroup Size: 5
Channel: 1 Item: Val
Number of readings stored: 0

Limits	Upper	Lower
Channel# 1	.000000	.000000
Channel# 2	.000000	.000000
Channel# 3	.000000	.000000
Channel# 4	.000000	.000000

Print List:

CHN		ITM	SEP
1	1	Val	☐☐
2	X	(blank)	(blank)

Math Functions: None

Part ID # 20

Part Number:
Description: Pt 20 1 Ch G1
Department:
Company:

Limits	Upper	Lower
Channel# 1	.000000	.000000
Channel# 2	.000000	.000000
Channel# 3	.000000	.000000
Channel# 4	.000000	.000000

Print List: NONE

Math Functions: NONE

Number of Characteristics: 1

Characteristic Data

Char ID # 21
Description: Ch 21 G Pt 2
Gage Identifier:
Subgroup Size: 5
Channel: 1 Item: Max
Number of readings stored: 0

Part ID # 30

Part Number:
Description: 2 Char Part
Department:
Company:

Limits	Upper	Lower
Channel# 1	.000000	.000000
Channel# 2	.000000	.000000
Channel# 3	.000000	.000000
Channel# 4	.000000	.000000

Print List: NONE

Math Functions: NONE

Number of Characteristics: 2

Characteristic Data

Char ID # 31
Description: First Char
Gage Identifier:
Subgroup Size: 5
Channel: 1 Item: Val
Number of readings stored: 0

Char ID # 32
Description: Second Char
Gage Identifier:
Subgroup Size: 5
Channel: 1 Item: Max
Number of readings stored: 0